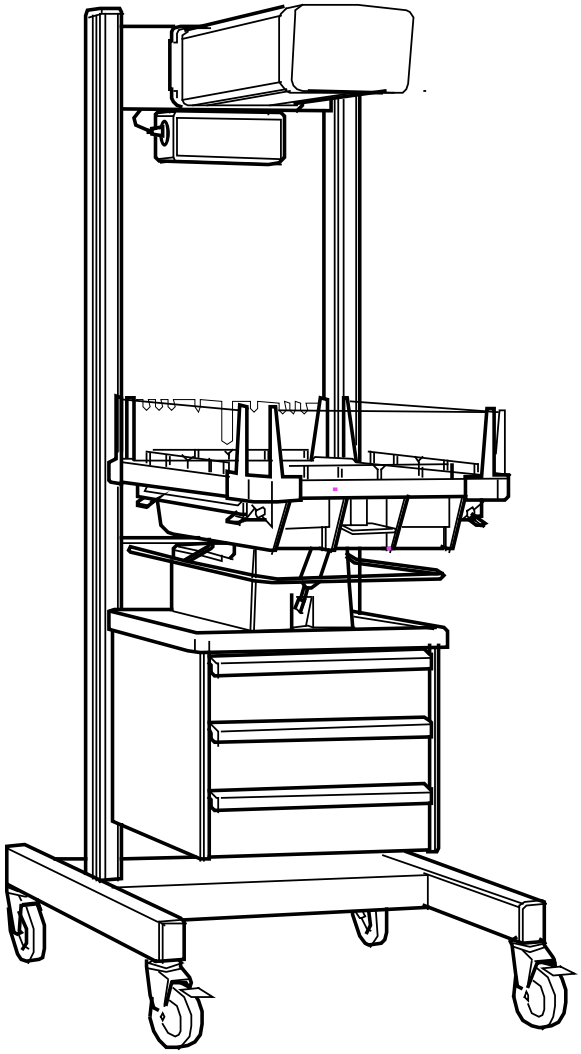
OHMEDA Medical

Ohio® Infant Warmer Systems

Service Manual

Models
2001
3000
3050
3100
3150
3300
3400
3500
4000
4300
4400
5000



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About this manual revision

This service manual contains information about models with heater heads that swing to the right and about new Armoire models that retract into cabinets.

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Important

The information contained in this service manual pertains only to those models of products which are marketed by Ohmeda as of the effective date of this manual or the latest revision thereof. This manual was prepared for exclusive use by Ohmeda service personnel in light of their training and experience and the availability to them of proper tools and test equipment. Consequently, Ohmeda provides this manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that a customer has received said information from Ohmeda does not imply in any way that Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or device is referred to within, or that abnormal or unusual circumstances may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review, update and revision. Customers are cautioned to obtain and consult the latest revision before undertaking any service of the equipment.

CAUTION

⚠ Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this service manual which is clearly and thoroughly understood.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions MUST be observed. Use the static control work station to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

Technical Competence

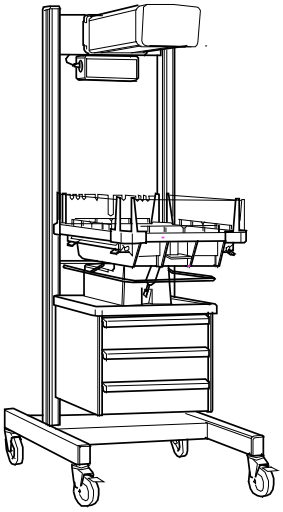
The procedures described in this service manual should be performed by trained and authorized personnel only. Maintenance should only be undertaken by competent individuals who have a general knowledge of and experience with devices of this nature. No repairs should ever be undertaken or attempted by anyone not having such qualifications.

Genuine replacement parts manufactured or sold by Ohmeda must be used for all repairs.

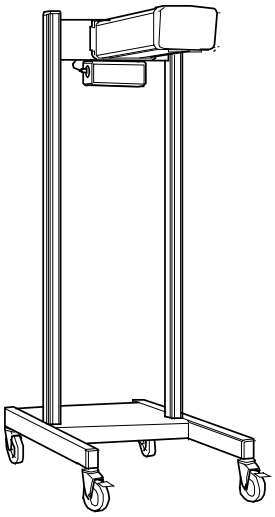
Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

Model Descriptions

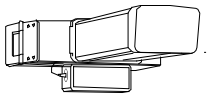
2001 IWS (International only)



3000 IWS



3050 IWS



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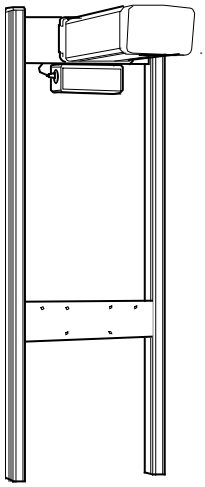
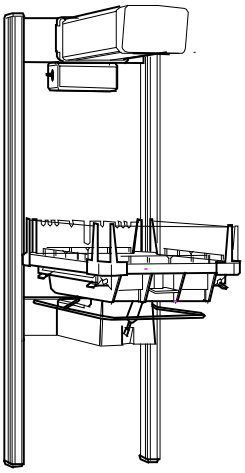
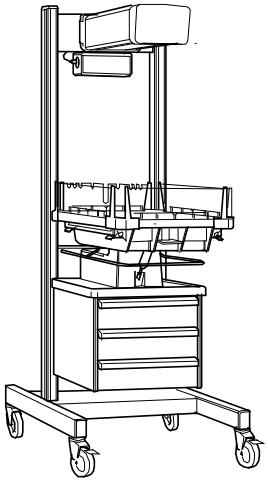


Cl.11.003, Cl.05.071, Cl.05.072, Cl.05.073

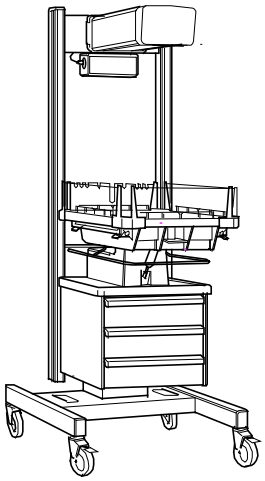
3150 IWS



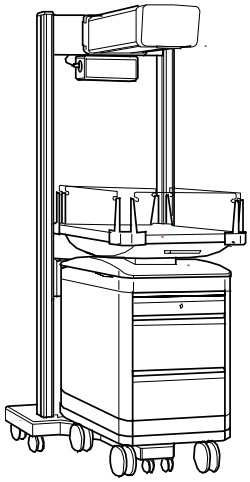
3300 IWS



3400 IWS

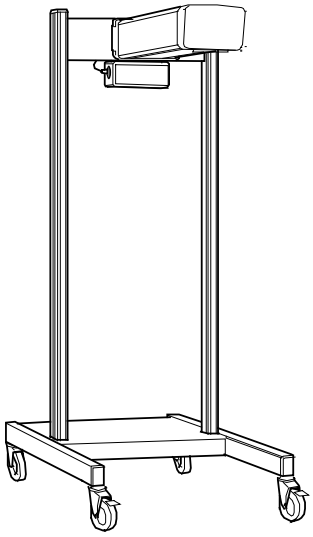


3500 IWS

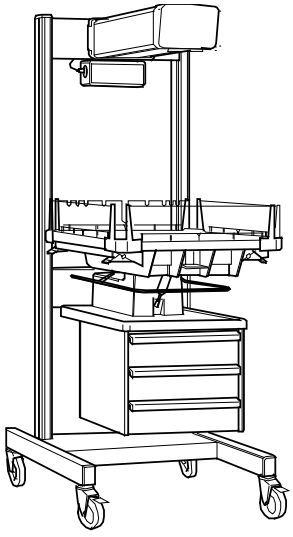


Cl.05.074, Cl.11.003, Cl.05.075, Cl.10.022

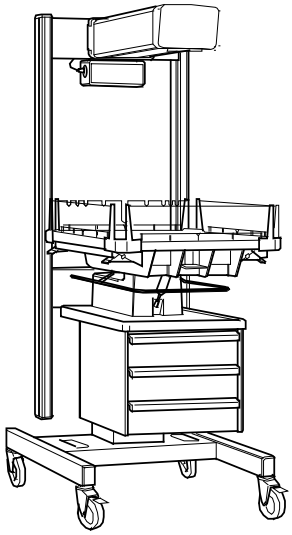
4000 IWS



4300 IWS



4400 IWS



Cl.13.004, Cl.13.005, Cl.13.006

Model Descriptions

All models of the Ohmeda Infant Warmer System provide a controlled source of radiant heat for infants and pediatric patients. The control system uses a microprocessor and provides both manual and servo modes of operation (except for the 2001 International, which is manual mode only).

The model 2001 International has an integral infant bed and is a manual mode only warmer designed for short term attended care in the OR and L&D.

The wall mounted 3050, 3100 and 3150 models are available to accommodate specific architectural requirements in the NICU, L&D, LDR and LDRP room. The 3050 is a heater head only, the 3100 is a heater and dove tail rails, and the 3150 includes a heater, rails and integral bed.

The model 3300 and 3400 have integral beds for infants and are intended for procedures and long term care in the Nursery and L&D. The 3400 is equipped with an elevation pedestal to raise and lower the bed.

The model 3000, 3500 and 4000 are free standing Warmers which can be used over a variety of infant bassinets in the general nursery, over post-operative patients, during patient feeding, and in any other application where controlled radiant heat is required.

The 3500 system also has a detachable bassinet for infants, and is intended for procedures and long term care in the Nursery, L&D, LDR and LDRP Rooms.

The model 4300, 4400 and 5000 have a larger size bed than the model 3300 and are intended for surgical procedures and long term care in the Nursery and L&D Rooms. Both the 5000 and 4400 have an elevating pedestal to raise and lower the bed-to-floor height. The model 4400 has a narrower foot print than the 5000 warmer. The model 4300 is a non-elevating version of the 4400.

	Small Heater/Bed			Large Heater/Bed	
	2000 Series	3000 Series	3500 Series	4000 Series	5000 Series
Free Standing		3000	3500†	4000	
Wall mounted, heater head only		3050			
Wall mounted heater with rails		3100			
Wall mounted heater with rails and bed		3150			
Free standing with integral bed	2001	3300		4300	
Elevating pedestal		3400		4400	5000

† Detachable bassinet and wood grain finish standard.

Definitions

Note: A Note provides additional information to clarify a point in the text.

Important: An Important statement is similar to a note but used for greater emphasis.

CAUTION: A Caution statement is used when the possibility of damage to the equipment exists.

WARNING: A Warning statement is used when the possibility of injury to the patient or the operator exists.

Symbols

Attention! Consult the manual for more information.

Type B equipment.

Functional Earth Terminal

Protective Earth Terminal

Increase % Power or Control Temperature

Decrease % Power or Control Temperature

Alarm Silence

Alternating Current

Do not place an infant on this surface

Static Control Precaution

CE European Union Repesentative

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⚠Warnings

Do not install the control board without ESD shielding in place. Failure to do so may result in hazardous ESD induced failures.

After completing a repair, the appropriate calibration procedure must be performed. After completing any portion of the calibration and adjustments procedures, perform the Checkout Procedure to make sure the Infant Warmer System is in proper operating condition. In addition, a final electrical safety check and leakage current test must be performed. If the unit fails any steps of the Checkout Procedure it must be removed from service and repaired. Record the information for future reference.

Do not perform the Checkout Procedure (Mechanical and Control Unit) while a patient occupies the warmer.

Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

Heater to be spacing less than the recommended 25 inches will result in incorrect operation and may adversely affect patient.

On wall mounted units, never place a patient in the bed when the heater is in the service position. Never leave the unit unattended in the service position or with either pin removed.

Overloading the shelves can affect the stability of the unit. Limit the load to 20 lbs. (9 kg) per instrument shelf, mounted to a single upright, and 50 lbs. (23 kg) per monitor shelf, mounted between the uprights.

Limit the load of accessories to 50 pounds (23 kg) per side on the Warmer to ensure stability. Accessories should not be mounted more than 56 inches (142 cm) above the floor. For models 3000 and 3500, limit the load of accessories to 20 pounds (9 kg) maximum per side mounted no more than 44 inches (112 cm) above the floor.

Due to the increased height of units with the ECMO option installed, a tipping hazard exists. Limit the total accessory load to 50 lbs. (23 kg), no more than 25 lbs. (11 kg) per side of the infant warmer.

Overloading the drawers can affect the stability of the unit. Limit the load to 10 lbs. (4.6 kg) per drawer, 20 lbs (9kg) per deep drawer.

Do not place any accessories or other objects directly over the bed surface. This may block radiant energy and lead to cooling of the infant.

Do not place items on top of the heater assembly. Items placed on top of the heater assembly can fall and injure the patient, and prevent adequate ventilation of the heater assembly.

Regularly inspect the bed side panel latching mechanism, and the bedside locking mechanism on the model 3500, to ensure proper operation.

Disconnect the power to the warmer and allow the heat tube to cool before cleaning or replacement to avoid the possibility of a burn.

When lowering or lifting the Infant Warmer System to and from the floor for inspection or repair, use two people for safety. Always ensure that you lay the unit on its right side (as viewed from the front) when laying the unit down. The heater/lamp housing does not lock and pivots to the left for access.

Disconnect the warmer power cord and allow the unit to cool before replacing the observation or alarm light. The lamp normally operates at a high temperature.

Due to the size and weight of the warmer at least two people are required to replace a caster.

Before any disassembly or repair disconnect the power supply, gas pipeline supply connections, remove any gas cylinders and remove any accessories from the uprights.

The replacement heater tube must match your unit. Earlier small bed units have 440 Watt Heaters. Newer units, with serial number beginning with HCA and HCC, have a 540 Watt heater. Installing the new 540 Watt heater tubes in the older units without HCA or HCC serial numbers may shorten the life of the power supply board. Check the serial number located on the back panel of the display module against the parts listed in 7/Illustrated Parts to verify you have ordered the correct replacement part.

When disassembling the elevating base, observe the following safety precaution to avoid electrical shock hazard from high voltage. Safely discharge the capacitor prior to removing any connectors.

When servicing the elevating bed column, depending on the position of the upper column in relation to the lower column, the springs could be heavily or lightly tension loaded. Use care when releasing the springs.

Do not use oil or oil bearing materials on or near the regulator. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. The air or oxygen regulators or any regulator parts must be discarded if contaminated with oil or grease. Only competent individuals trained in the repair of high pressure gas equipment should attempt to service it. Unqualified repairs may result in serious injury or equipment damage.

On Model 3400 and 4400 warmers factory equipped with drawers, if the drawers are removed and not re-installed, a leg weight must be installed in the right leg of the unit to ensure stability before the warmer can be placed in service.

Enclosing the heater assembly inside a cabinet may prevent proper ventilation and may create a fire hazard. If the heater is enclosed in a cabinet, it must be equipped with a power cut-off device that prevents operation while the cabinet is closed.

The 3050 heater assembly weighs approximately 30 lbs (14 kg). Proper installation may require two people. Due to the weight of the 3100 and 3150, the 3100 weighs approximately 75 lbs. (34 kg) and the 3150 weighs approximately 110 lbs. (50 kg), proper installation will require two people.

Use of electrosurgical units or other electrical field radiating equipment can affect the operation of the warmer. Keep patient probe lead as far away as possible from electrosurgical cables. Do not allow excess electrical cables to be laid on the warmer table. Use of electrosurgical units or other instruments which radiate electrical fields can cause indirect heating, by several tenths of a degree of the thermistor probe due to absorbed electrical energy. When used in this manner, operate the warmer in manual mode for maximum safety.

Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. *Vac Kote is the oxygen service lubricant recommended.

*Vac Kote is a trademark of the Ball Corporation.

When servicing an oxygen manifold, use only new Ohmeda parts as shown in this manual. Because of the high pressure gas application, it is essential that you never substitute parts from another manufacturer or use parts that are not clean for oxygen service.

When replacing gauges, verify that pressure range of the replacement gauge is the same as the one you are replacing, and that the correct gas is shown.

The patient probe is not isolated from earth ground. Any additional equipment used with the Ohmeda Infant Warmer System must comply with UL 544, CSA 22.2, IEC 601, and VDE 750.

The computer or RS-232 monitor's user program must continuously check the data link. The program should constantly verify connection to the warmer controller and check for updated data.

Keep hands clear of the hinge area when installing a wall mounted heater assembly. A pinch hazard exists.

⚠Cautions

Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this service manual which is clearly and thoroughly understood.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions must be observed. Use the static control work station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Detailed drawings and procedures for more extensive repairs are included herein solely for the convenience of users having proper knowledge, tools, and test equipment, and for service representatives specially trained by Ohmeda. No repair should ever be undertaken or attempted by anyone not having such qualifications.

When removing cables, always grasp the connector on the sides and gently remove the cable connector from the board. This will prevent weakening of the cable assembly. Never remove the connector by pulling on the cable.

When servicing the bed hydraulic system, the tubing must not be stretched, pinched or kinked during reassembly. If the tubing is pinched, the bed will not tilt and damage and oil leaks may result.

During heater rod removal or replacement, hold terminal to ensure no strain is placed on the element.

Yoke check valves are not intended to provide a leak free seal; always use a yoke plug and a fresh cylinder gasket to seal an unused yoke.

Use only one cylinder gasket per yoke. Using more than one gasket could cause a cylinder gas leak.

To prevent the drawers from opening unintentionally while moving the detached bassinet, move it from the front only.

Open cylinder valves S-L-O-W-L-Y to avoid damaging the regulators.

Insulation on the electrical wiring can deteriorate with age. Check for brittle or deteriorated insulation on the power cord and all other electrical wires.

On elevating models, do not continue to run the motor at upper and lower limit positions; equipment damage may result.

The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

Infant Warmer Systems (IWS) models shipped with Serial Number HCA and HCC have a electronic controller common to all models. This change was made to simplify servicing future IWS models. Also, to comply with international standards, the heater assembly, power supply and cable harness were modified.

A new surface mounted component control board, software revision level 06.00 and higher, is described in section 1.1. Prior boards with through mounted components, software revision levels 04.01 through 05.10, are described in section 1.2., and section 1.3 describes control boards with software revision levels prior to 04.01.

Section 1.4 provides a description of the new surface mounted component display board; section 1.5 describes the previous through mounted display board.

Section 1.6 provides detailed functional description of the power supply PCB. Section 1.6.2 and 1.6.3 describes power supply board designs used in earlier IWS product.

A functional description of the ThermaLink option is provided in section 1.7.

1.1 Control Board (6600-0521-700)

This is a functional description for the IWS controller board, which is used in all IWS models with Software Revision 6.0 or higher. Refer to Section 8 for a detailed circuit diagram.

The warmer electronics consist of a microcontroller printed circuit board (PCB), a display PCB and a power supply PCB. Section 1.1 provides a detailed functional description of the microcontroller PCB. Section 1.1 provides a detailed functional description of the microcontroller PCB including the A/D module. Section 1.2 provides a detailed functional description of the display PCB. Section

The control board regulates Infant Warmer operation. The board is designed around the 8032 microcontroller. The 8032 features: 256 bytes of RAM memory; 32 I/O lines configured as four parallel ports; three counter timers; a six source, two priority nested interrupt; a programmable serial I/O port; and an integral oscillator.

The control board also contains an EPROM, an oscillator circuit, a line frequency monitoring circuit, a watchdog alarm circuit, a multiplexer, an analog to digital converter, four transceivers, one input latch, and two output latches, and an audible alarm circuit.

Figure 1-1 presents a block diagram of the control board. The microcontroller's bi-directional data bus accesses the EPROM through a transparent octal latch. Circuitry attached to the microcontroller generates the 6 MHz system clock. A line frequency signal from the power supply board clocks one of the microcontroller timers to identify the power frequency (for use in the heater control algorithm) and to check for power failure.

The watchdog timer uses an RC circuit to verify that the microcontroller is operating properly and executing all software routines. If the watchdog circuit fails to receive the expected pulse, it times out. This opens the safety relay to shut off the heater, interrupts the microcontroller, and sounds the high priority alarm. At power up, the watchdog pulse is briefly suppressed to test the high priority (alternating two tone) alarm and the safety relay.

A multiplexer connects the analog signals to the ADC converter through an operational amplifier. Two signals test the ADC calibration. Inputs used are Patient Temperature and Line Compensation. Spare inputs are Ambient Temperature, Patient Temperature 2 and Patient Temperature 3. The line voltage compensation circuit tells the microcontroller what percent of the expected voltage input (nominal voltage) is

actually available. For example, if the heater receives a higher voltage than nominal, it produces more heat and needs to be on for fewer cycles. The patient temperature probe provides data for the servo mode control parameter and the display panel.

The chip selects input/output latches, transceivers and flip flops transfer information between the microcontroller and the I/O lines. The processor and flip flops U10 and U11 issue commands for alarm circuitry, bed position (elevating units only), observation light control, and normal heater control, data and clock information for the display.

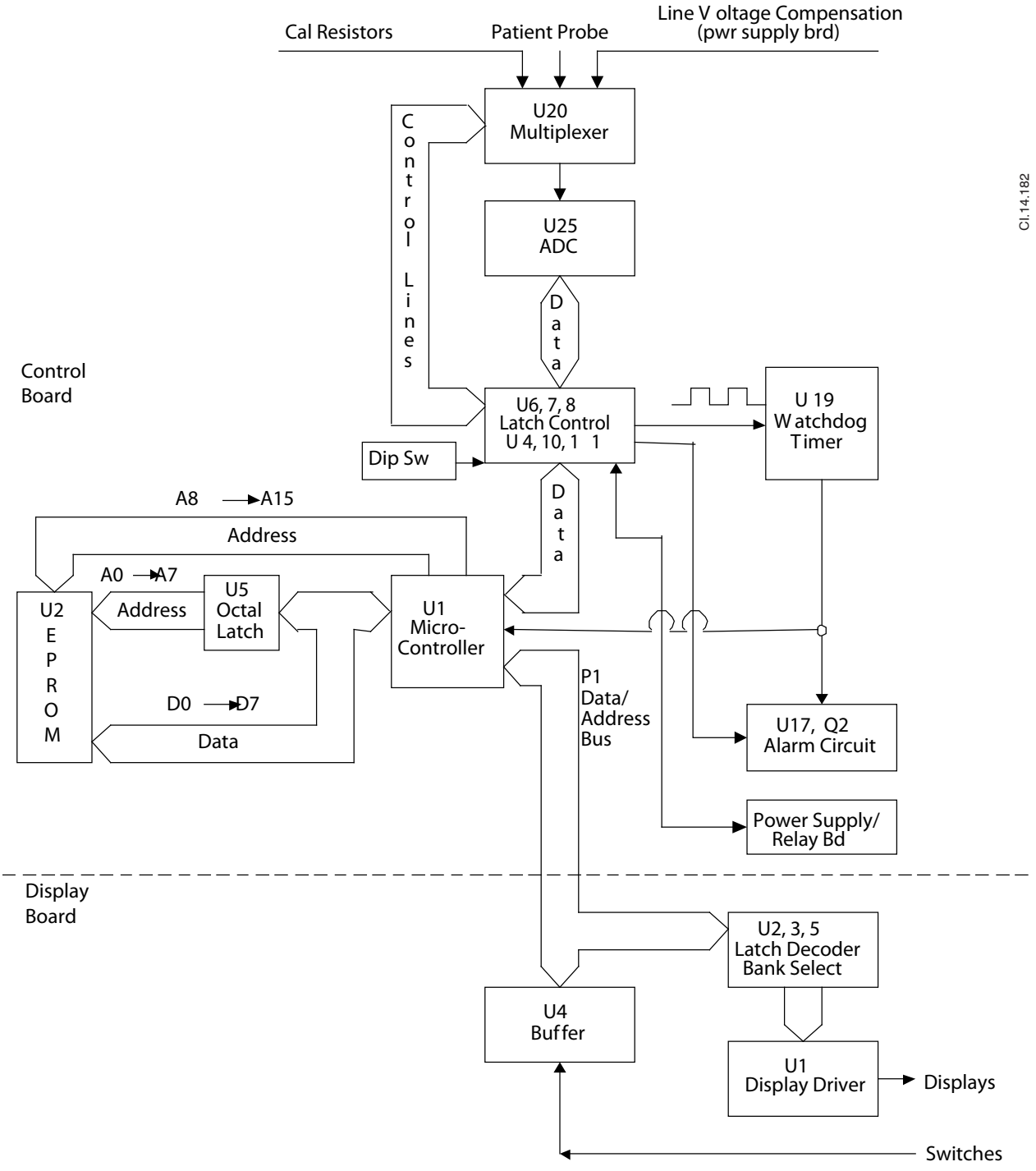


Figure 1-1
System Block Diagram (Software revisions 06.00 and higher)

1.1.1 Microcontroller

The 8032 microcontroller operates at a clock speed of 6 MHz. Grounding the EA line configures the microcontroller to execute instructions from the EPROM (U2). Four parallel ports link the microcontroller to other control board circuits.

Ports 0 and 2 send address bits to the EPROM. Port 0 also reads data from the EPROM. While port 0 transfers data, an octal latch (U5) continues to address the EPROM. Address bits from port 0 are latched into U5's outputs on the High to Low transition of the ALE signal.

Note: The ALE signal (U1 pin 33) has a 1 MHz frequency (approximately 0.33 μsecs On and 0.67 μsecs Off) with a 6 MHz system clock.

Port 1 communicates with the display board.

Port 3 performs miscellaneous functions:

- Line 3.0 & 3.1 Receive and transmit serial data to the optional ThermaLink Interface.
- Line 3.2 (INT0) monitors power frequency (50 or 60 Hz). See Section C, Line Frequency Circuit.
- Line 3.3 (INT1) interrupts the microcontroller if the watchdog circuit times out. See Section 1.1.3, Watchdog Circuit.
- Lines 3.4 and 3.5 respectively send serial data to and clock the display driver (display board).

A. Memory Allocation and Peripherals

The processor accesses the digital I/O ports via two different methods: Port 1 of the microcontroller (pins 2-9) interface to the display board, while all of the other ports are external memory mapped. Memory mapping the ports simplifies both the hardware and software, and allows for the use of common off the shelf parts to minimize the chance of obsolescence. The external data space is 64K bytes, and is divided up as indicated in the table below.

External Address Range

(hex)	Function	Port Type
0000h - 0FFFh	Expansion bus chip select	I/O
1000h - 1FFFh	SRAM chip select (U3)	I/O
2000h - 2FFFh	DIP switch port (U8)	Input
3000h - 3FFFh	Input Port #1 (U9)	Input
4000h - 4FFFh	Output Port #1 (U10)	Output
5000h - 5FFFh	Output Port #2 (U11)	Output
6000h - 6FFFh	ADC Latch Low (U6)	Input
7000h - 7FFFh	ADC Latch High (U7)	Input
8000h - FFFFh	(Future)	I/O

Table 1-1
External Data Space Decoding

Some of these peripherals, such as the input or output latches, have only one register. When these locations are accessed, all addresses within that range will contain the same value. For an output port, any address in this range can be written to. As an example, to write to Output Port #1, writing to address 4000h is the same as writing to address 4FFFh - only one write is needed to latch the data.

Address decoding is accomplished by decoding the upper address lines with a 74HC138 3-to-8 decoder. The top address line, A15, enables the device when it is low; this creates the 32K of address space for the expansion bus, as shown in Table 1-1. When enabled, one output of the decoder goes low, depending upon the state of the 3 address lines A12 through A14. The outputs are further qualified by /RD and /WR using OR gates U13 and U14. This prevents programming errors from writing to a read only port. It also prevents activating a port when accessing program memory, since only one of the signals /PSEN, /RD or /WR will be active for any given bus cycle. The table below defines the bits of the Input #1 port (U9).

Bit	Signal Name	Function
0	2KHz	556 timer - audible alarm frequency
1	Interlock Switch	Head position safety switch
2	HEATER_STATUS	High when AC is applied to heater
3	DATA_OUT	Read data from the EEPROM (U12)
4 to 7	“0”	Not used, grounded

Table 1-2
Input #1 bit definitions

The table below defines the bits of the Output #1 port (U10).

Bit	Signal Name	Function
0	HIGH_PRIORTY_ALARM	See Table 1-4
1	LOW_PRIORTY_ALARM	See Table 1-4
2	WATCHDOG_TIMER	Pulsed on a regular basis by firmware to keep the watch dog timer reset
3	NURSE-CALL-IN	Controls Nurse Call Interface 0 is on, 1 is off
4	MUX_A	Selects the analog channel to convert at the ADC
5	MUX_B	
6	MUX_C	
7	RUN/HOLD	Enables/disables the ADC conversions.

Table 1-3
Output #1 bit definitions

The lowest 2 bits of the Output #1 port are used to control the audio alarm. This alarm has four modes of operation: off, low priority (a constant 2 kHz tone) and two high priority (2 kHz alternated with a 1.75 kHz tone, at a 1 Hz rate). Table 1-4 identifies the alarm modes with the bit states. The table below identifies the alarm modes with bit states.

Bit 1	Bit 0	Mode
0	0	Low Priority
0	1	High Priority
1	0	Off
1	1	High Priority

Table 1-4
Alarm Bit Modes

The next table defines the bits of the output #2 port (U11)

Bit	Signal Name	Function
0	RELAY_CONT_IN	Controls safety relay
1	HEATER_CONTROL	Controls external heater solid state relay
2	LOWER_BED_CONTROL	Lower bed
3	RAISE_BED_CONTROL	Raise bed.
4	OBS_LITE_CONTROL	Activate observation light
5	AL_LITE_CONTROL	Activate alarm light
6	SERIAL_CLOCK	Clock for the EEPROM (U12) & EEPot (U18)
7	DATA_IN	Write data for EEPROM & UP/DN signal for EEPot

Table 1-5
Output #2 bit definitions

B. SRAM & EPROM

The SRAM (U3) on the board is 128K x 8 in size. Only 4K of the device is available to the processor (via the /CS1 chip select). Address lines A12-16 are hardwired to ground due to lack of an additional output port pin. This chip is currently not used and is available for future expansion.

The program for the processor is contained in a 512K x 8 EPROM (U2). The EPROM is located within the Program space, and is controlled by the processor via the /PSEN line. The processor can access up to the full 64K of program memory, allowing for firmware expansion.

An electrically erasable PROM (EEPROM) is located at U12. This is the common 93C46 serial EEPROM. Data is shifted in and out via a serial clock (SERIAL_CLOCK). The chip select for the device is generated by pin 9 of the processor. This chip is currently not used and is available for future expansion.

1.1.2 Line Frequency Circuit

The line frequency circuit converts a 60 or 50 Hz sinusoidal signal into a square wave that clocks the heater control software and checks for power failure.

The line frequency signal originates with a nominal 8 Vac from a transformer secondary that is routed through the power supply board. The line frequency circuit half rectifies the ac signal (D2) and passes it through a NAND gate (U16) to generate the final pulse. Because the NAND gate does not respond until the input exceeds 1.9 Vdc, the pulse duty cycle is slightly higher than 50%.

1.1.3 Watchdog Timer

U19 and related circuitry is the watchdog timer. The processor firmware generates regular pulses to the WATCHDOG_TIMER signal (via output port U10). This keeps the device constantly triggered. If the software should stop re-triggering the timer (due to hardware or software failure, for example), the device times out. This causes a number of things to occur:

- An interrupt is generated to the processor -INT1 pin. If the fault is in software, this may bring the software back on track and correct the problem.
- The high priority alarm is enabled. For a software error, this signal will be asserted so briefly that no alarm may be heard. For true faults, the alarm will sound.
- The RELAY_CONTROL signal is de-asserted, disabling the heater relay K1 and the heater.

1.1.4 Temperature Measurement

A. Analog Inputs

External patient inputs are filtered with pi filters consisting of two capacitors and an inductor. The patient probe uses a negative temperature coefficient thermistor in series with a 5.76 kΩ resistor fed by a source voltage VREF of 1VDC. The multiplexer U20 feeds the desired input channel to a buffer U23. The signal passes through a low pass filters R56 and C24 and then to the IN_HIGH input of U25, a 7109 analog to digital converter.

B. Reference voltage

The reference voltage for the thermister probes and the ADC is generated by U21, an LM385 1.2V band gap reference. This voltage is sent through a divider and a low pass filter consisting of R48, R49 and C23, and is then buffered by U22, another voltage follower op-amp.

C. Multiplexer (MUX)

The multiplexer (U20) is a 74HC4051 with eight normally open switches and a common output terminal. To select a signal for conversion, the microcontroller toggles the multiplexer control lines (pins 11, 10, and 9) through U10. The selected signal is connected to output pin 3, through a buffer U23 to the ADC.

Control inputs to the multiplexer are as follows:

Control Inputs A B C	On Switches	Pin No.	
0 0 0	X0	13	calibration value 25.05°C
0 0 1	X1	14	calibration value 37.97°C
0 1 0	X2	15	patient probe 1
0 1 1	X3	12	line compensation
1 0 0	X4	01	ambient (future)
1 0 1	X5	05	spare patient probe 2
1 1 0	X6	02	spare patient probe 3
1 1 1	X7	04	unused

Note: Because the multiplexer's inhibit line is tied Low, it does not affect switch selection.

D. A/D Converter

The analog to digital converter section is totally ratiometric. This means that all of the analog measurement circuitry, from the sensor voltage to the A/D converter reference voltage, is a function of Vref, the analog reference voltage. This means that Vref's accuracy can be less critical.

U24 is a switched capacitor DC/DC inverter, which generates -5V from the 5V supply rail. This voltage is needed by the ADC and the op-amps. L4, C36 and C37 create a separate analog Vcc plane and electrically isolate the plane from any noise on the digital Vcc plane of U25.

The ICL7109 generates an output based upon the difference in voltage between the IN_HI and IN_LO inputs. By raising the IN_LO pin above ground, this voltage is effectively subtracted from the input voltage, achieving the input scaling without external components. This DC offset voltage is controlled by RP3 (DC_OFFSET). The full scale value of the ADC is set by RP2, the SPAN_ADJUST potentiometer. This adjusts the voltage applied to the REF_IN+ pin, the ADC reference voltage.

E. Connectors and Test Points

Connector	Function
TP1	Test Point connector, used during debug and field service
J1	Head interlock
J2	(Future)
J6	Display/front panel switch connector
J5	Power supply/Relay board
J7	Patient 1 probe input
J9	Nurse call interface
J25	(Future)
J24	Expansion bus interface

Table 1-7
Connector and Test Point Identification

Pin	Function	Pin	Function
1	+5V_STDBY	9	GND
2	ALARM OFF	11	SW7
4	+5V_DSPLY	12	SW8
5	+9V_STDBY		
8	2KHZ		

Table 1-8
TP1 Connector Pin Identification

F. Start-up Self Test of ADC

1. Calibrate High Resistor

This signal is generated by a voltage divider network with a resistance equal to that of the patient probe at a temperature of 37.97°C. The circuit uses the same 1 Vdc supply as the patient probe. During normal operation, the microcontroller checks the converted value of this signal to check for any drift in the ADC reference voltage. If the converted value differs from the expected value by more than 0.3 °C for one minute, Calibration High Error 02 triggers.

2. Calibrate Low Resistor

This signal is generated by a voltage divider network, with a resistance equal to that of the patient probe at a temperature of 25.05 °C. The circuit uses the same 1 Vdc supply as the patient probe. During normal operation, the microcontroller checks the converted value of this signal to check for any drift in the operational amplifier that adjusts the ADC input. If the converted value differs from the expected value by more than 0.3 °C for one minute, System Failure (Calibration Low) Error 03 triggers.

3. Line Voltage Compensation

Knowing the actual operating voltage allows the microcontroller to maintain the desired level of heater output for line voltage fluctuations up to ±10%.

The line voltage compensation signal is generated on the power supply board and passes through the same amplifier network as the patient probe and the calibration high and low signals. The initial line voltage compensation circuit can be adjusted on the power supply board independent of the ADC. Refer to Section 4.6, Line Voltage Compensation, for details.

1.1.5 Audible Alarm

The alarm tones are generated by a 556 dual timer. The leftmost timer is software controlled and generates a 1 Hz 50% duty cycle square wave, which is used to generate the two tone high priority alarm. The second timer generates the signal that goes to the transducers.

The output of the second slot of the LM556C timer is used to generate both a 2 kHz and a 1.75 kHz signal. If the output from the second slot is a logic “0”, the transistor, Q2, will not be conducting. If the output from the first slot is a logic “1”, the transistor, Q2, will be conducting.

Q1, an MMBT3904 NPN transistor, is used to switch the capacitor C12 in and out of the circuit, altering the frequency of the tone generated. This pin is connected to a resistor ladder inside the device. By applying a voltage to this pin, the thresholds of the internal comparators are changed, affecting the output frequency.

The circuit voltage controls the sound volume. VR1 is an LM317L adjustable voltage regulator. Its output voltage is controlled by RP1, a multiturn potentiometer, or U18, a Xicor nonvolatile EEPot under software control. Resistors R12 and R14 are added to control the range of the pots. Note that only one of the two variable resistors (RP1 or U18) will be installed.

By shorting pins 1 and 2 of TP1, the audio circuit can be muted. This ties the threshold and trigger pins on the second timer of the LM556C timer to +5V_STDBY, which stops the multivibrator from toggling. This also allows the processor to detect the disabled timer, preventing field service or manufacturing from releasing a board into service with the alarm disabled.

1.1.6 Heater Control

A. Calculating Heater Cycles

The heater control routine uses the concept of proportional control. This means that all levels of heater output are given as a percentage of the maximum heater output, defined as the amount of heat produced when the heater is switched on for 50 cycles a second at 100% of its nominal line voltage.

Proportional heater control uses a three step routine:

- Step 1: Adjust the defined, maximum heater output for the actual line voltage: at higher voltages, fewer cycles/sec are required to deliver maximum heat; at lower voltages, more cycles are required to deliver maximum heat.

Actual Voltage	ON cycles for Maximum Heat
103.5V (90% nominal)	60 cycles/sec
115V (100% nominal)	50 cycles/sec
126.5V (110% nominal)	40 cycles/sec

  Refer to Section 1.3.2, Line Voltage Sensing, for more information about the line voltage compensation signal used to measure the voltage.

- Step 2: Determine what percentage of the maximum heater output is required:

  In the manual mode, you directly set the percentage of the maximum heater output on the bar graph. In the servo mode, the controller calculates the difference between the patient temperature and the control temperature (or the patient temperature gradient, PTG) and adjusts the heater output.

- Step 3: Calculate the number of cycles:

  Number of cycles = ON cycles for Max Heat (step 1) x %max heat (step 2)

B. Monitoring Heater Cycles

An opto-isolator circuit across the heater relay generates the monitoring signal for the microcontroller. The opto-isolator (power supply board component U3) generates a logic low which is inverted on the control board. The final signal (High = heater On) is sampled by the microcontroller through U9 and also runs the heater status LED (light = heater On). Because of the duty cycle, the LED flickers instead of pulsing as it did on the previous boards.

C. Signals That Override Normal Heater Control

Watchdog alarms, raise and lower bed switch activation, interlock switch status, and self tests (transparent to the user) can override normal heater controls:

- During a watchdog alarm, watchdog pulses stop and the watchdog timer opens the safety relay through U15.
- When the raise or lower bed switches are active, the microcontroller temporarily shuts down the heater to limit current. Although these switches are only labeled on elevating IWS models, they are present on all IWS units and will switch Off the heat if activated.
- When the interlock switch is open, the microcontroller assumes that the controller is in the x-ray position and shuts down the heater.
- At power up, the microcontroller closes the interlock safety switch through U9 by setting the safety relay line Low. The line remains Low as long as power is switched On.

Signal	Test Points and Logic Level
Heater control	U11 pin 5; High = On
High priority alarm	U10 pin 2; High = alarm
Watchdog alarm	U10 pin 6; Low = alarm
Raise bed switch	U11 pin 9; High = raise bed
Lower bed switch	U11 pin 6; High = lower bed
Interlock switch	U9 pin 3; High = heater in X-ray position
Safety relay	U11 pin 2; Logic Low except during system fail alarm
Heater status	U9 pin 4; High = On (LED lights)

Note: To maximize safety relay life, relay function is only tested at power up by allowing the watchdog timer to time out.

1.2 Control Board (6600-0218-700)

This is a functional description for the IWS controller board, which is used in all IWS models with Software Revision 4.01 through 05.10. Refer to Section 8 for a detailed circuit diagram.

The control board regulates Infant Warmer operation. The board is designed around the 8032 microcontroller. The 8032 features: 256 bytes of RAM memory; 32 I/O lines configured as four parallel ports; three counter timers; a six source, two priority nested interrupt; a programmable serial I/O port; and an integral oscillator.

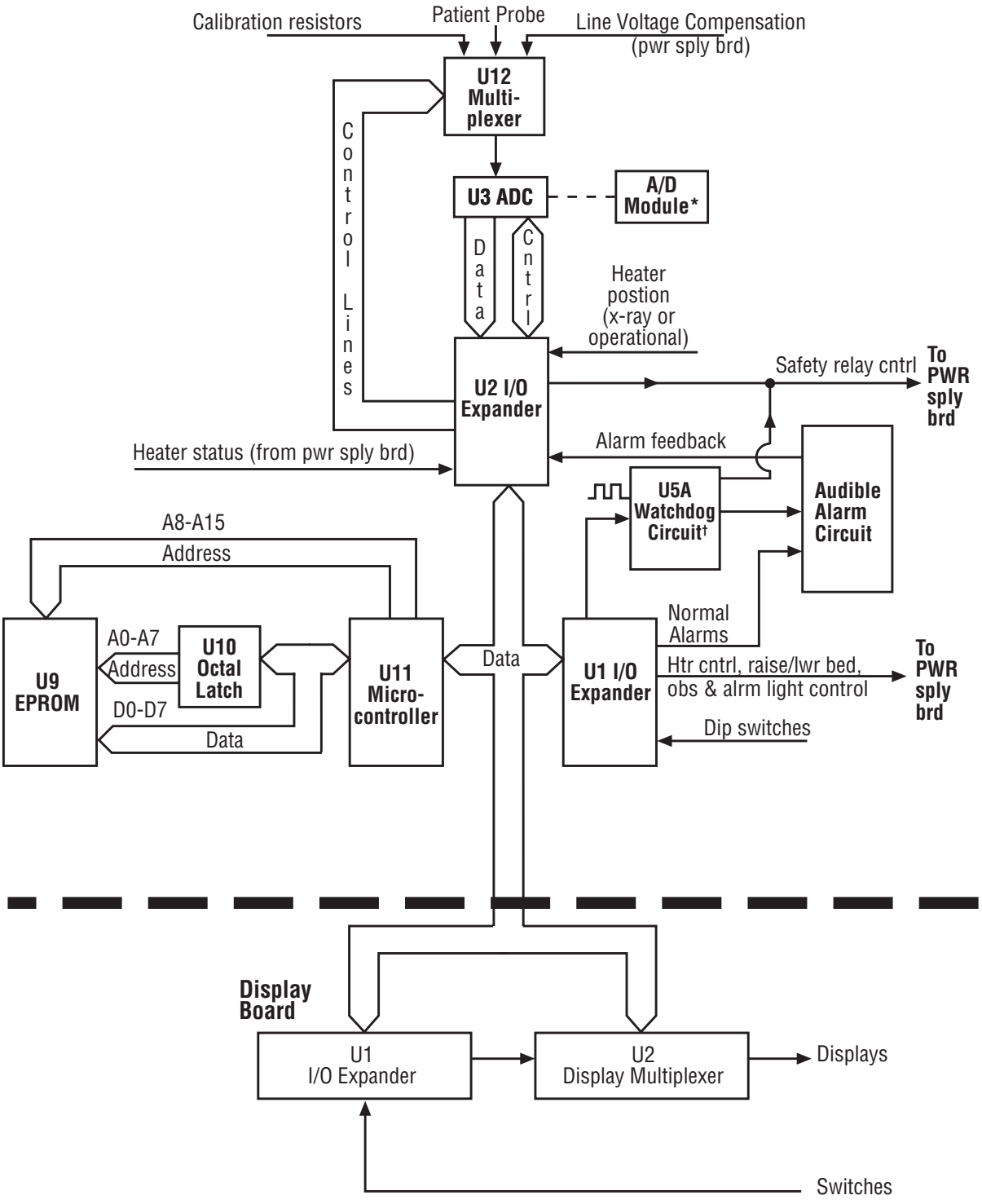
The control board also contains a UV erasable EPROM, an oscillator circuit, a line frequency monitoring circuit, a watchdog alarm circuit, a multiplexer, an analog to digital converter, two on-board I/O expanders, and an audible alarm circuit. A third I/O expander on the display board tells the microcontroller when a controller switch is pressed.

Figure 1-3 presents a block diagram of the control board. The microcontroller's bi-directional data bus accesses the EPROM through a transparent octal latch. Circuitry attached to the microcontroller generates the 6 MHz system clock. A line frequency signal from the power supply board clocks one of the microcontroller timers to identify the power frequency (for use in the heater control algorithm) and to check for power failure.

The watchdog timer uses an RC circuit to verify that the microcontroller is operating properly and executing all software routines. If the watchdog circuit fails to receive the expected pulse, it times out. This opens the safety relay to shut off the heater, interrupts the microcontroller, and sounds the high priority alarm. At power up, the watchdog pulse is briefly suppressed to test the high priority (alternating two tone) alarm and the safety relay.

A multiplexer connects the analog signals to the ADC converter through an operational amplifier. Two of the signals test the ADC calibration. The remaining two are used to measure patient temperature and to sense the mains voltage. The line voltage compensation circuit tells the microcontroller what percent of the expected voltage input (nominal voltage) is actually available. For example, if the heater receives a higher voltage than nominal, it produces more heat and needs to be on for fewer cycles. The patient temperature probe provides data for the servo mode control parameter and the display panel.

I/O expanders transfer information between the microcontroller and the rest of the unit. One I/O expander controls ADC conversions. It also monitors the heater status, whether or not the heater assembly is in the X-ray position, proper audible alarm function, and closes the safety relay at power up. A second I/O expander provides the watchdog pulse; issues commands for alarm circuitry, bed position (elevating units only), observation light control, and normal heater control; and checks the position of the internal switches. Data and clock information for the display pass directly from the microcontroller to a third I/O expander located on the display board.



* On units with A/D daughter board
† Watchdog circuit produces feedback signal for microcontroller

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Figure 1-2
System Block Diagram (software revisions 04.01 through 05.10)

1.2.1 Microcontroller

The 8032 microcontroller operates at a clock speed of 6 MHz. Grounding the EA line configures the microcontroller to execute instructions from the EPROM (U9). Four parallel ports link the microcontroller to other control board circuits.

Ports 0 and 2 send address bits to the EPROM. Port 0 also reads data from the EPROM. While port 0 transfers data, an octal latch (U10) continues to address the EPROM. Address bits from port 0 are latched into U10's outputs on the High to Low transition of the ALE signal.

Note: The ALE signal (U11 pin 30) has a 1 MHz frequency (approximately 0.33 μsecs On and 0.67 μsecs Off) with a 6 MHz system clock.

Port 1 communicates with the three I/O expanders. Bits 5-7 enable the individual I/O expanders. Sending a logic Low on one (and only one) of these outputs enables the corresponding I/O expander. Bits 0-3 hold instructions to be executed by the enabled I/O expander on the High to Low transition of bit 4.

Port 3 performs miscellaneous functions:

- Line 3.0 & 3.1 Receive and transmit serial data to the optional ThermaLink Interface.
- Line 3.2 (INT0) monitors power frequency (50 or 60 Hz). See Section 1.2.2, Line Frequency Circuit.
- Line 3.3 (INT1) interrupts the microcontroller if the watchdog circuit times out. See Section 1.2.3, Watchdog Circuit.
- Lines 3.4 and 3.5 respectively send serial data to and clock the display driver (display board).

1.2.2 Line Frequency Circuit

The line frequency circuit converts a 60 or 50 Hz sinusoidal signal into a square wave that clocks the heater control software and checks for power failure.

The line frequency signal originates with a nominal 8 Vac from a transformer secondary that is routed through the power supply board. The line frequency circuit half rectifies the ac signal (CR1) and passes it through a Schmitt trigger NAND gate (U7B) to generate the final pulse. Because the NAND gate does not respond until the input exceeds 1.9 Vdc, the pulse duty cycle is slightly higher than 50%.

1.2.3 Watchdog Timer

Note: Unlike earlier versions of the control board, the watchdog pulse continues during all high priority alarms except those for software upset and system failure.

I/O expander U1 pulses a retriggerable, monostable multivibrator (U5A). During normal operation, another watchdog pulse arrives before the end of the U5A's output pulse (0.263 second duration). This keeps the timer output High.

If there is a software upset, the watchdog pulse stops and the multivibrator output goes low. This causes the safety relay to open, interrupts the microcontroller, and activates the audible alarm circuit:

- The safety relay is opened by inverting the watchdog timer's Q output (High = alarm). Note that holding U8A's other input Low configures it as an inverter.
- To interrupt the microcontroller, the watchdog timer's Q output is gated with two unused address lines (U8C and U4B).
- To activate the audible alarm circuit, the watchdog timer's Q output and the high priority alarm command line are NAND gated (U7A).

During the power up test, the watchdog pulse is briefly interrupted to check the watchdog circuit, the safety relay and the audible alarm.

1.2.4 Analog to Digital Converter

A multiplexer connects analog monitoring signals to the ADC through an op-amp. Both the multiplexer and the ADC converter are controlled through an I/O expander.

A. Multiplexer (MUX)

The multiplexer (U12) is a MC14051B with eight normally open switches and a common output terminal. Only four of the switches are used. To select a signal for conversion, the microcontroller toggles the multiplexer control lines (pins 11A, 10B, and 9C) through I/O expander U2. The selected signal is connected to the common output and applied to an operational amplifier (U15A) that subtracts approximately 0.368 mV (calibrated by adjusting R52, ADC High Adjust). The operational amplifier output is tied to the ADC input through a 75 kΩ resistor.

Control inputs to the multiplexer are as follows:

Control Inputs	On Switches	Pin No.	
A B C			
0 0 0	X0	13	calibration value 25.05°C
0 0 1	X1	14	calibration value 37.97°C
0 1 0	X2	15	line voltage monitor
0 1 1	X3	12	unused
1 0 0	X4	01	patient probe
1 0 1	X5	05	unused
1 1 0	X6	02	unused
1 1 1	X7	04	unused

Note: Because the multiplexer's inhibit line is tied Low, it does not affect switch selection.

B. Analog to Digital Converter (ADC)

1. Analog to Digital converter (ADC), units with 3711 chip at U3.

The ADC, U3, operates asynchronously, continuously converting analog voltage inputs into a number of counts between 0 and 3999 (BCD format). The conversion rate is set by an internal oscillator whose frequency is determined by the external components R1 and C10. The exact oscillator frequency is not critical and may vary by ± 15% from the nominal 400 kHz. The oscillator frequency may be measured on pin 18 (U3). With a nominal 400 kHz clock frequency, the ADC completes approximately three conversions a second.

The ADC communicates with the microcontroller through I/O expander U2. The ADC data latch is permanently enabled by tying pin 19 (DLE) Low. The start conversion and conversion complete signals synchronize the data conversion, which proceeds as follows:

a. The start conversion pulse from the microcontroller triggers a new conversion, prematurely ending any conversion in progress.

b. The conversion complete output goes Low on the falling edge of the start conversion pulse. It returns to a High level when the ADC completes the conversion. The Low to High transition prompts the microcontroller to read the ADC output.

c. The first set of data (from the prematurely terminated cycle) is discarded since there is no way to determine if it represents an entire conversion.

d. The microcontroller waits until the new conversion cycle has been completed.

e. The data is read by the microcontroller, converted to temperatures or voltage percentages and stored in RAM.

The BCD data is output on data lines 2^0 to 2^3 (U3 pins 23, 24, 3, and 4 respectively) in accordance with the coded digit select signals applied to the ADC digit select inputs D0 and D1 (U3 pins 20 and 21 respectively). The digit select codes are summarized below:

ADC Control Inputs

DLE*	D0	D1	Digit
L	L	L	0 (LSD)^
L	L	H	1
L	H	L	2
L	H	H	3 (MSD)#

* Signal is tied Low.

^ Least Significant Digit (e.g., 2 in 3992)

Most Significant Digit (e.g., 3 in 3992)

1a. Analog to Digital Converter (ADC),units with A/D module on the daughter board

The ADC is a dual slope, integrating ADC with auto-zero function. The ADC operates in an “on demand” mode. When instructed to by the microcontroller the ADC converts the analog voltage at its input into a number of counts between 0 and 4096. The conversion rate is set by crystal Y1 on the A/D module board. A single conversion takes 132 ms. Components C3, C4, C5, and R1 are used by the ADC to integrate the voltage signals and perform internal zeroing.

The ADC communicates with the microcontroller through I/O expander U2. The ADC data latches are permanently enable by tying the high byte enable and low byte enable Low. The Run/Hold and Status signals synchronize the data conversions, which proceeds as follows:

a. The ADC begins conversion when a high signal is present on its RUN/HOLD pin.

b. When the conversion is complete and the digital data has been latched onto the outputs of the ADC pulls the status line low.

c. To insure that the analog input signal has stabilized the first three data conversions are discarded and another conversion is initiated.

d. The fourth conversion data is read by the microcontroller, converted to temperature or voltage percentages and stored in RAM.

4 to 1 Multiplexer
The 4 to 1 multiplexer circuit consist of two 4 to 1 multiplexers (U2 and U3 on A/D module). U2 and U3 act as 4 bits (nibble) data selectors for the microprocessor. The microprocessor selects a nibble of data at a time. The select lines of each of the 4 to 1 multiplexers, pin 2 of U2 and U3 and pin 14 of U2 and U3 are configured so that they provide the microprocessor with two select lines. The truth table below shows the output.

D0 pins 14	D1pins 2	Data line selected	Data Description
0	0	1C0 and 2C0	B1-B4
0	1	1C1 and 2C1	B5-B8
1	0	1C2 and 2C2	B9-B12
1	1	1C3 and 2C3	A/D Signature

The 12 bits of data are present in the first three data nibbles. The fourth nibble is permanently wired so that the output will always be 1000B. This allows the microprocessor to identify the type of ADC converter being used.

C. ADC Reference Voltage

The ADC uses an adjustable reference voltage of 2.0 Vdc (test point 10), generated from an LM-10. The LM10's internal reference source provides a 200 mV supply that is amplified to a nominal 1.08 Vdc by the reference buffer portion of the LM-10 (U14B, test point 8). The operational amplifier portion of the LM-10 adjusts the voltage to the required 2.0 Vdc. The initial 1.08 Vdc is fixed, but the final reference voltage can be adjusted using R44, ADC Low Adjust.

For units with the A/D module on the daughter board, the 2 volt reference is applied to a voltage divider network on the A/D module made up of R2 and R3. The voltage developed across R3 is used as a voltage reference for the ADC. The nominal voltage reference to the ADC is 278.3 mv.

D. -5 Volts Supply, units with the A/D module on the daughter board

The -5 volt supply is required by the ADC converter to properly bias the chip, operate the internal switches, and as a supply for the internal integrator. The -5 volts is created by U4 which is a DC to DC converter. U4 contains an internal 10 KHz. clock that controls the internal switches. During the first half cycle of the clock the C1 is connected to +5 volts and ground. During the second half cycle C1 is disconnected from the + 5 volts and ground and connected across C2 so that the polarity is inverted. This creates a negative voltage that is proportional to the +5 volt in. Vout (pin 5) should be -4.8 volts +/-0.4 v. with no more than 0.2 ripple.

E. ADC Inputs

Patient Temperature Probe

The patient temperature probe uses a negative temperature coefficient thermistor in series with a 5.76 kΩ resistor to generate a signal that is linearly proportional to the temperature. The 1 Vdc supply used by the probe is generated by the internal 200 mV reference on the LM-10 (U14B), the same 1 Vdc source used to generate the ADC reference voltage.

Probe Temp.	Equivalent Resistance	Voltage Signal*	Op amp out (ADC input)*	ADC Counts*
20°C	12526 Ω	728 mV	355 mV	2581
25°C	10000 Ω	675 mV	303 mV	2201
30°C	8037 Ω	621 mV	248 mV	1806
35°C	6500 Ω	566 mV	193 mV	1407
40°C	5289 Ω	513 mV	140 mV	1013

* All voltages and ADC counts are approximate.

Calibrate High Resistor

This signal is generated by a voltage divider network with a resistance equal to that of the patient probe at a temperature of 37.97°C. The circuit uses the same 1 Vdc supply as the patient probe. During normal operation, the microcontroller checks the converted value of this signal to check for any drift in the ADC reference voltage. If the converted value differs from the expected value by more than 0.3 °C for one minute, System Failure Error 02 triggers.

Calibrate Low Resistor

This signal is generated by a voltage divider network) with a resistance equal to that of the patient probe at a temperature of 25.05 °C. The circuit uses the same 1 Vdc supply as the patient probe. During normal operation, the microcontroller checks the converted value of this signal to check for any drift in the operational amplifier that adjusts the ADC input. If the converted value differs from the expected value by more than 0.3 °C for one minute, System Failure Error 03 triggers.

Line Voltage Compensation

Knowing the actual operating voltage allows the microcontroller to maintain the desired level of heater output for line voltage fluctuations up to ±10%.

The line voltage compensation signal is generated on the power supply board and passes through the same amplifier network as the patient probe and the calibration high and low signals. The initial line voltage compensation circuit can be adjusted on the power supply board independent of the ADC. Refer to Section 4.4.5, Line Voltage Compensation, for details.

% Nominal Voltage	Line Comp Signal (Pwr. Sply. Brd)* ^	Op amp out (ADC input)*	ADC Counts
90%	600 mV	232 mV	1600
100%	660 mV	292 mV	2000
110%	720 mV	352 mV	2400

* Approximate values.

^ Measured at power supply board test point 11 or the multiplexer input.

1.2.5 Audible Alarm Circuit

The alarm circuit consists of an audio transducer (LS1) and two timers. During a low priority alarm, the microcontroller sends a 1 Hz square wave to the reset pin of timer U6A through I/O expander U1 and NAND gate U7C, producing a 2 kHz (one second On, one second Off) alarm.

During a high priority or a watchdog alarm, the NAND gated output of the high priority alarm and the watchdog alarm (U7C) activates both timers with the first timer feeding a 1 Hz square wave to the control line of the second. A 1 mΩ resistor changes the output frequency, producing an alternating two tone alarm.

If both a low and a high priority alarm are in progress, U7C suppresses the low priority alarm to keep both timers active.

The alarm circuit allows volume (R37) and frequency adjustments (R38). You can measure the actual alarm frequency at test point 1. During a high priority alarm, the microcontroller monitors this signal through I/O expander U2 to verify alarm execution.

1.2.6 Heater Control

A. Calculating Heater Cycles

The heater control routine uses the concept of proportional control. This means that all levels of heater output are given as a percentage of the maximum heater output, defined as the amount of heat produced when the heater is switched on for 50 cycles a second at 100% of its nominal line voltage.

Proportional heater control uses a three step routine:

- Step 1: Adjust the defined, maximum heater output for the actual line voltage: at higher voltages, fewer cycles/sec are required to deliver maximum heat; at lower voltages, more cycles are required to deliver maximum heat.

Actual Voltage	Maximum Heat
103.5V (90% nominal)	60 cycles/sec
115V (100% nominal)	50 cycles/sec
126.5V (110% nominal)	40 cycles/sec

  Refer to Section 1.6, Line Voltage Sensing, for more information about the line voltage compensation signal used to measure the voltage.

- Step 2: Determine what percentage of the maximum heater output is required:

  In the manual mode, you directly set the percentage of the maximum heater output on the bar graph. In the servo mode, the controller calculates the difference between the patient temperature and the control temperature (or the patient temperature gradient, PTG) and adjusts the heater output.

- Step 3: Calculate the number of cycles:

  Number of cycles = Max Heat (step 1) x %max heat (step 2)

B. Monitoring Heater Cycles

An opto-isolator circuit across the heater relay generates the monitoring signal for the microcontroller. The opto-isolator (power supply board component U3) generates a logic low which is inverted on the control board. The final signal (High = heater On) is sampled by the microcontroller through I/O expander U2 and also runs the heater status LED (light = heater On). Because of the duty cycle, the LED flickers instead of pulsing as it did on the previous boards.

C. Signals That Override Normal Heater Control

Watchdog alarms, raise and lower bed switch activation, interlock switch status, and self tests (transparent to the user) can override normal heater controls:

- During a watchdog alarm, watchdog pulses stop and the watchdog timer opens the safety relay through U8A.
- When the raise or lower bed switches are active, the microcontroller temporarily shuts down the heater to limit current. Although these switches are only labeled on elevating IWS models, they are present on all IWS units and will switch Off the heat if activated.
- When the interlock switch is open, the microcontroller assumes that the controller is in the x-ray position and shuts down the heater.
- At power up, the microcontroller closes the safety switch through I/O expander U2 by setting the safety relay line Low. The line remains Low as long as power is switched On.

Signal	Test Points and Logic Level
Heater control	U1 pin 16; High = On
High priority alarm	U1 pin 18; Low = alarm
Watchdog alarm	U5A pin 13; Low = alarm
Raise bed switch	U1 pin 14; High = raise bed
Lower bed switch	U1 pin 15; High = lower bed
Interlock switch	U2 pin 15; High = heater in X-ray position
Safety relay	U2 pin 17; Logic Low except during system fail alarm
Heater status	U2 pin 14; High = On (LED lights)

Note: To maximize safety relay life, relay function is only tested at power up by allowing the watchdog timer to time out.

1.3 Control Board (6600-0048-700)

This is a functional description for the control board in Infant Warmer System units prior to Software Revision 4.01. Refer to Section 8 for a detailed circuit diagram. When replacing this board, order controller service kit:

6600-0360-800	EMI Noise Suppression Kit for English IWS Models
6660-0360-801	EMI Noise Suppression Kit for French IWS Models
6600-0360-802	EMI Noise Suppression Kit for Spanish IWS Models
6600-0360-803	EMI Noise Suppression Kit for German IWS Models
6600-0360-804	EMI Noise Suppression Kit for Spanish IWS 2001 Models
6600-0360-805	EMI Noise Suppression Kit for French IWS 2001 Models
6600-0360-806	EMI Noise Suppression Kit for English IWS 2001 Models

Each controller service kit includes EMI shielding to minimize susceptibility of the replacement controller board to Electrostatic discharge, power line conducted and radiated electromagnetic interference. See 7/Illustrated parts for kit contents.

WARNING ⚠ Do not install the control board without ESD shielding in place. Failure to do so may result in hazardous ESD induced failures.

To confirm that your IWS unit has shielding already in place, remove the controller cover. The large silver foil control board shield should be the first thing you see. Refer to Figure 7-1.

The control board contains electronic circuitry involved with the measurement, control, computation, memory, logic, and decision making functions of the Infant Warming System. The principal IC on this board is the 8031 single component, 8-bit microcontroller. The 8031 has: an internal read/write memory (RAM) of 128 bytes, 32 I/O lines configured as four 8-bit parallel ports, two 16-bit timers, a five source two priority nested interrupt, a programmable serial I/O port, and an on-chip oscillator with clock circuitry. The program memory is stored in a 2764, 64k bit (8k x 8), or a 27128 128K bit (16k x 8) UV EPROM. An octal transparent latch (74LS373) is connected to address inputs of the EPROM to permit the use of the bi-directional data bus port of the microcontroller for addressing the EPROM and receiving program instructions.

Four ICs with a network of precision resistors are used to interface temperature measured to the microcontroller. The temperature sensor, calibration resistors, or line voltage scaler are selected by an MC14051B 8 Channel Multiplexer. An LM-10 precision reference with adjustable reference buffer, and on-board operational amplifier furnishes a stable reference supply. This is required by the temperature measurement circuits and the ADC 3711 Analog to Digital Converter. An 8243 I/O expander is used to interface the microcontroller with the multiplexer and the A/D converter.

The control board is also equipped with several ICs that form the triac watchdog circuit, watchdog timer, and the audio alarm tone generator. The audio transducer for the alarm signals and its driver circuit are also included on the control board.

Detailed operation of the circuits listed in the preceding paragraph is explained in the following sections.

1.3.1 Microcontroller

The control system is located in the 8031 microcontroller. It operates at a clock speed of 6MHz and can be verified by measuring the frequency at the Address Latch Enable (ALE) pin to be 1 MHz (On = 0.33 μsec and Off = 0.67 μsec). The EA pin is grounded which enables the 8031 to execute instructions from an external memory device.

When the microcontroller performs a read instruction from EPROM, the low order address (8 bits) is output from Port 0 while the high order address (6 bits) outputs from Port 2. (Note: Bit 6 is configured only to provide expansion compatibility with a fully programmed 27128 EPROM). The ALE pin goes High allowing the LS373 to appear transparent between the EPROM and the microcontroller. After the ALE output goes Low, the low order address is latched to the outputs of the D flip flops within the LS373. This allows the EPROM to remain addressed by the microcontroller, and return 8 bits of data while using only two ports.

Port 1 of the 8031 is used to communicate to the three 8243 I/O expanders. Bits 5-7 are connected to the Chip Select (CS) line of the first, second, and third respective I/O expanders. Providing a Low signal on one and only one of the outputs activates the corresponding IC. Bits 0-3 hold the instruction to be carried out by an 8243 when the enable bit 4 transitions between High and Low.

Port 3 is used to perform remaining tasks required by the control system. Connections 3.0 and 3.1, (receive and transmit respectively), are used in conjunction with the serial interface chips so that communication to an external microcomputer is possible. Connection INT0/P3.2 is a line frequency interrupt line that is used to aid in timing subroutines found within the system software. Connection T0/P3.4 sends serial data to the display driver while connection T1/P3.5 provides clocking to the driver.

1.3.2 Line Frequency

The line frequency circuit converts the 60 or 50 Hz sinusoidal line voltage signal into a square wave signal. The output of the circuit is used to clock the 4020B counter (U9) and to provide a low frequency clock source for the system software. The 1N4001 diode (CR1) half-wave rectifies the 8 Vac (nominal) signal which is divided by potential divider R45/R16 and inputted to the Schmitt trigger NAND gate (U8, pin 5). With one line tied High, the output of the trigger will be inverted. Since the gate will not respond until the input exceeds 1.9 Vdc minimally, the duty cycle of the output will be slightly more than 50%.

1.3.3 Heater Status

The Heater Status function signals the microcontroller and the safety circuitry as to whether or not the heater is On or Off. The input to the Schmitt trigger (U8, pin 13) is High if the heater is Off and Low if the heater is On. Small glitches appear when the heater is On. Consult the Functional Description of the power supply board for further explanation. The output of the NAND gate is inverted because one input is tied High.

1.3.4 Hardware TRIAC Test

The 4020B 14 bit binary counter, U9, counts at a rate equal to the line frequency and responds to the negative edge of the clock pulse. The clock signal is received from a Schmitt trigger NAND gate, pin 6 of U8. The counter resets when the 74LS123 retriggerable one shot flip flop outputs a High level pulse on the Q output line. With CLR tied High and A tied Low, the counter will reset when B of the 74LS123, U3, is High at a time equal to (Q5) +(Q13) +(Q14) or after 12304 counts (Q5 = 16, Q13 = 4096, Q14 = 8192). Approximately 6.19 μsec. later the output of the one shot will return to its initial Low state.

Q13 and Q14 of the 4020B are tied to a 2 input NAND gate (U2, pins 1 and 2) which will go High after 12288 counts. After 8 counts Q4 of the counter goes High. Q4 is tied to the CLR pin of D flip flop U1. When CLR goes High, the output of Q1 (U1 pin 5) is allowed to equal the input D on the next positive edge of the clock pulse. Therefore the output at pin 5 will update after 9 counts. After 12288 counts (3.4133 minutes on 60 Hz units, or 4.096 minutes for 50Hz units) the signal at the D input of the flip flop goes High. This signal is also input to the microcontroller through the I/O expander U4. The software will then switch Off the heat. Nine counts later the High input on D is clocked to the output Q. The heater status (Off-Low, On-High) sent from the Schmitt trigger NAND gate pin 11 of U8 is always present at the input of U2 pin 5. If the heater is still On after 9 counts, the output of the NAND gate pin 6 of U2 will clock the second D flip flop. The outputs of the flip flops switch - Q goes High and NOT Q goes Low. A Low on NOT Q sets off the audio alarm and drops out the non-resettable safety relay causing the heater to switch Off.

1.3.5 Heater Status LED

A heater status LED is located on the control board for troubleshooting. The LED can be seen through the rear of the controller assembly cover. When the status line from the Schmitt trigger is High, (heater On) the transistor Q2 switches On causing the LED to emit light. If heat is Off, the LED is Off.

1.3.6 Watchdog Timer

A watchdog timer is used to “check” that the microcontroller is working properly. After every cycle through the system software the microcontroller sends a Low pulse to the A input of U3, a 74LS123. The RC network connected to the RxCx and Cx pins create a time constant, t = 0.45 x R x C = 0.263 seconds. If a pulse is not received at the input before the time constant expires, the output will go Low. The high priority alarm will then be activated due to the microcontroller failure. Note when the microcontroller detects a high priority alarm condition, pulses to the watchdog circuit stop.

1.3.7 Alarm Tone Generator and Control Circuits

The alarm circuit consists of an alarm tone generator and control circuitry for high or low priority alarm conditions. Under a no alarm condition the 7556 timers are both inactive, (reset lines Low).

1.3.8 Low Priority Alarm

Under normal operating conditions the input to U8 pin 9 is High. When the microcontroller detects a low priority alarm, a 1 Hz square wave is output to U8 pin 9. The timer activates, causing a 2 kHz audio output. This results in a one second On, one second Off audio alarm. The 2.050 kHz signal is adjusted within ± 100 Hz by R38. The volume of the audio alarm is adjusted by R37. The volume is set at the factory and should not normally require adjustment.

1.3.9 High Priority Alarm

The high priority alarm is activated if the microcontroller quits sending pulses to the watchdog timer. This occurs when a high priority alarm condition is detected or if the microcontroller fails. The high priority alarm is also activated if the hardware triac test circuitry detects a failed triac. Both timers become active with one timer feeding a 1 Hz signal to the control line of the second. The 1 MΩ resistor changes the output frequency of the second timer to produce a warbling effect (two tone alternating alarm). If high and low priority alarms are both On, the output of the NAND gate overrides the low priority signal, keeping both timers active.

1.3.10 Analog to Digital Converter

Temperatures are measured using a negative temperature coefficient thermistor that is calibrated for specific resistance values and interchangeability. Analog voltage signals inversely proportional to temperature are derived from a voltage divider network consisting of a 5.76kΩ ± 0.1% resistor in series with the temperature sensor. The voltage source for the measuring circuit is obtained from the LM-10's internal precision reference source of 200 mV amplified to a nominal 1.0 Vdc by the reference buffer of the LM-10. The Op-amp portion of the LM-10 provides an adjustable reference of 2.0 Vdc nominally, which is required by the A/D converter, U6. In addition to the patient probe, there are three other voltage divider networks on the control board. Two have fixed output and are used for calibration check points of the A/D system at 25.0 and 37.9 °C. The third divider network is unused.

A separate input to the control board A/D circuit comes from the line voltage monitor network located on the power supply board.

The outputs of all the voltage dividing networks are connected to individual switch input terminals of U13, the MC14051B Analog Multiplexer. The MC14051B contains eight normally open switches with a common output terminal. The common output of the MUX (pin 3) is tied through R9 to the analog input (pin 9) of the A/D converter. The microcontroller selects which sensor is to be measured by toggling the control lines, pin 11(A), pin 10(B), and pin 9(C) of the MUX via the 8243 #2, U5. The following table shows the digital codes used to select the individual switches of the MUX:

Control Inputs	ON Switches	Pin No.	
A B C			
0 0 0	X0	13	calibration value 25.0 °C
0 0 1	X1	14	calibration value 37.9 °C
0 1 0	X2	15	line voltage monitor

0 1 1	X3	12	unused
1 0 0	X4	01	patient probe
1 0 1	X5	05	unused
1 1 0	X6	02	unused
1 1 1	X7	04	unused

Note: Inhibit terminal (pin 6) of the MUX has no effect on the switch selection because it is tied Low through R19 (200 Ω).

The ADC 3711, U6, uses a pulse modulation analog to digital conversion technique. The conversion rate is set by the frequency of an internal oscillator whose frequency is determined by the external components R4 and C14. The exact oscillator frequency is not critical and may vary by ±15% from the nominal 400 kHz. The oscillator frequency may be measured on pin 18 of U6. With a nominal 400 kHz clock frequency, conversions within the ADC 3711 will take place at an approximate rate of 3 per second.

The ADC 3711 will output BCD data on demand in accordance with the coded digital signals applied to the digit select inputs D0 and D1, pins 20 and 21 respectively. The data latch enable is tied Low, therefore, the BCD data of the A/D converter will be output to the microcontroller through 8243 #2 in conformance to the following codes that are applied to the digit select inputs:

D0	D1	Selected Digit
L	L	Digit 0 LSD
L	H	Digit 1
H	L	Digit 2
H	H	Digit 3 MSD

Note: The magnitude of the selected digit is present at pins 3, 4, 23 and 24.

The ADC 3711 is continuously converting the analog voltage present at its input to a number of counts between 0 and 3999 (BCD format). Therefore, the start conversion, input at pin 7, and the conversion complete, output at pin 6, are mis-named. The start conversion input only controls the transfer of information from the internal counter to the digital latches. The conversion complete output goes to a logic Low on the rising edge of the start conversion pulse which is issued by the microcontroller. The conversion complete will go to a logic High sometime later when the new conversion information has been transferred to the display latches. The start conversion pulse may occur at any time in the conversion cycle because the microcontroller is running asynchronously to the A/D clock. Therefore, the amount of time from the start to finish will vary. The maximum time difference between the start conversion and conversion complete pulses in this application is about 300 msec.

The operation of the temperature and line voltage measurement circuits can be summarized as follows:

The analog voltage signal derived from a voltage divider network and a precision reference source is directed to the input of the A/D converter through an eight channel analog multiplexer. For the line voltage measurement, the voltage source is obtained from the rectified, filtered, and unregulated output of the power transformer. Switch selection is software controlled by the microcontroller which toggles the A, B, and C input lines of the multiplexer.

The analog voltage is converted in the ADC 3711 to a digital signal in four digit BCD format (0 to 3999 counts). The microcontroller sends a start conversion pulse to the ADC 3711 which then starts to update the digital data in the output latches. When all of the counts have been internally transferred, the A/D converter toggles the conversion complete output line. The microcontroller then reads the individual BCD digits using coded signals to the digit select lines of the A/D converter.

1.3.11 ADC Calibration

The A/D converter is calibrated by connecting a 5900 ± 0.1% Ω resistor to the patient probe jack and placing the DIP switch on the control board in the following position:

Switch #1 Open (Off)

Switch #2 Open (Off)

Switch #3 Open (Off)

Switch #4 Closed (On)

Potentiometer R44 on the control board is then adjusted until the elapsed time display reads exactly 1122. With the DIP switches in the given position the patient temperature display will read out the actual patient temperature, even if it is outside of the normal range, and the control temperature display will read out the percent of nominal line voltage.

During operation, the calibration of the A/D conversion system may be checked by pressing and holding the hidden switch located above the ALARM SILENCE SWITCH on the control panel. After 2 seconds, the patient temperature display should read 25.0°C and the control temperature display should be 37.9°C. The elapsed timer should read the applied line voltage, expressed as a percentage of the nominal voltage, ± 2%.

1.3.12 Heat Control Routine

A. Calculating Heater Cycles

Proportional control of the heater power is obtained by varying the number of full heat cycles of ac current delivered to the heater. To allow for line voltage compensation and still have at least 20 discrete levels of heat, a proportioning range of 0 to 60 full heat cycles is used. In other words, at very low line voltages, 100% heat will be output by having the heat On for 60 full cycles out of a possible maximum of 60. Similarly, at this low line voltage 90% heat is obtained by having the heat On for 54 out of 60 cycles.

B. Manual Mode Heat Control

In the “manual” mode of operation, the heat output is determined by the bar-graph setting selected by the operator. There are 20 steps on the bar-graph so each step represents a 5% heat increment. To accomplish the desired compensation for line voltage variations, the maximum number of heat cycles is calculated based on the last measurement of the power line voltage. For 115 Vac nominal units, a line voltage of 106 Vac or less will increase the maximum number of heat cycles to 60. At greater than 125 Vac the maximum number of heat cycles is limited to 40 cycles out of a possible 60. Therefore, the number of cycles of current furnished to the heater in the manual mode is determined by multiplying the maximum for the line voltage present by the bar-graph setting. For example: assume the line voltage is 115 Vac (maximum number of cycles On = 50) and the bar-graph setting is 30%; the number of heat cycles to be output will be 0.3 times 50 = 15 cycles. Under these conditions the heat will be On for 15 cycles and Off for 45 cycles, this sequence will continue until the line voltage changes or the setting is changed on the bar-graph.

C. Servo Mode Heat Control

In the “servo” mode, the heater power is controlled by comparing the patient’s skin temperature to the selected value of control temperature. The difference between the control temperature and the patient temperature is referred to as “PTG” (patient temperature gradient). A positive PTG indicates a patient is cooler than the control temperature and a negative PTG occurs when the patient temperature is higher than the control temperature. Based on the magnitude and sign of the PTG, a software look-up table is used to find the percent heat required. The percent heat is then converted to the appropriate number of bar-graph steps and then the selected amount of heat is output by the same process used in the manual mode.

A hardware circuit is used to interrupt the microcontroller once every cycle of the ac power line. During the interrupt routine, two registers are decremented to keep track of the heater On and Off cycles. One register is used for counting the number of cycles in one second (60) and another register is loaded on every sixtieth count with the number of heat cycles to be output. A flag is set whenever this register is not zero, the heat is On only when this flag is set.

D. Monitoring Heater Cycles

The operation of the heat control software and the heat output hardware are repeatedly tested during operation of the warmer. An opto-isolator connected with a series resistor directly across the heater terminals is used to monitor heater power supply voltage. The output of the opto-isolator is fed into a Schmitt trigger, which outputs directly to an input port of the microcontroller. Therefore, the microcontroller can verify if the heat is actually On when it is supposed to be On. If not, a system fail alarm will be activated. Approximately every three minutes, an external hardware network (safety circuit) signals the microcontroller to switch Off the heat. This hardware also monitors the output of the Schmitt trigger (heater status line). If the heater power is not switched Off after a short delay, the hardware circuit will
de-energize the “safety” relay to switch Off heater power and also initiate an alarm which cannot be silenced without switching the power Off.

1.4 Display Board

This is the functional description of the surface mounted Display board. Refer to section 8 for a detailed circuit diagram.

The display board is the interface between the operator and the control system. It informs the operator about the warmer and patient status. The operator controls the system by depressing the various switches on the front display. The control board uses P1 bank as bi-directional data lines, plus several timer and control lines for the display unit.

A. Switch Decoding

Signals pass between the micro controller and the display board, at a rate of approximately 1 MHz. Command words are latched in U2 and decoded in U3 on the high to low transition of the PROG line and decoded to set a high impedance on the selected port lines. U4 and U5 are connected to the front panel switches. When a switch is depressed, the corresponding line is pulled low and loaded into U4 or U5 and is transferred to the micro controller depending on which address is selected by the decoder, U3 and the low to high transition of the PROG line.

B. LED Displays

The LED display driver, U1, controls the LED displays. Data is input to pin 25 synchronously with the clock signal (pin 24). The first bit activates the driver, and 35 data bits follow. After the 35th bit is loaded, data is latched to provide direct output. Because the output is inverted, a logical 1 input switches ON the appropriate LED at the output.

Display brightness is factory preset, but can be adjusted at RP1 for voltage at R13.

C. Multiplexing of Displays

To minimize the number of driver lines required, displays are multiplexed through U1. Displays are divided into four groups: control temperature LEDs, patient temperature LEDs, Apgar timer, and miscellaneous LEDs (mode, alarm and heater power). U1 (LED Driver) turns on a Darlington transistor to select the active display channel. The large gain of the Darlington allows a small current to sustain the load current from the LEDs.

Bits 1-29 supply the necessary information to each section. Bit 30 is tied to R13, a 221 ohm ± 1% resistor, used for calibration. After each of the four display groups has been serviced, a string of 35 zeroes is sent on the data line to reset the driver for the next string of data; the driver operates with serial input and does not have a master reset.

The basic display circuit (one LED) includes: the +5 V DISP supply from the control board routed through the diode D2, the collector emitter junction of the enabled Darlington transistor, the LED, and the MM5451 decoder.

1.5 Display Board (0631-5031-700)

This is a functional description for the through hole component Display Board. Refer to section 8 for a detailed circuit diagram.

The display board provides the interface between the operator and the control system. It displays the status of the unit, the patient status, and can also be used as a diagnostic aid. The operator controls the system by depressing the various switches on the front display. Operation of the display board is simplified with the use of two ICs: the 8243 I/O expander which is used in conjunction with the switches; and the MM5451 (or MM5450) driver used in conjunction with the LED display.

Switch Decoding

The I/O expander, U1, is always enabled in the read mode because its sole purpose is to detect switch depressions. The 8243 is activated by the microcontroller sending a Low signal on the Chip Select (CS) line. A control word (4 bits) is latched from the input port 2 on the High to Low transition of the PROG pin. The word is decoded as follows:

P23	P22	Instruction Code	P21	P20	Address Code
0	0	Read	0	0	Port 4
0	1	Write	0	1	Port 5
1	0	OR	1	0	Port 6
1	1	AND	1	1	Port 7

As soon as the read instruction and the port address are decoded the corresponding port lines are set to a High impedance state and the input buffers within the 8243 are switched On. When a switch is depressed on the display, the respective line switches Low and is loaded into the input buffer. The Low to High transition on the PROG line terminates the read instruction and transfers information back to port 2. When the microcontroller sets the CS line High the 8243 is disabled.

LED Display Driver

The LED display driver, U2, controls the LED displays. The displays are multiplexed with a duty cycle of 20% and a refresh rate of 60 Hz. Data is input to pin 22 synchronously with the clock (pin 21). The first “1” bit activates the driver and 35 data bits will follow. After the 35th bit is loaded, the data is latched to provide direct output. Note that a logic High at the input switches the output Low and switches On the LED connected to the output (output is inverted).

Brightness Adjust

R9 is used to adjust the output current from U2 which in turn changes the brightness of the LEDs. R9 is adjusted to produce 3.30 ± 0.10 Vdc across R10 (3.3 V/221Ω ~15 ma). C6 is used to prevent oscillations at pin 19.

Multiplexing of Displays

Since there are not enough data bits to drive the entire display, the displays are divided into four sections. Bits 1-28 are used to supply the necessary information to each section. Bit 29 is unused. Bit 30 is tied to a 221Ω ± 1% resistor which is used for calibration. Bits 31-34 select which channel of the display is activated by switching On a Darlington transistor. The Darlington provides a large gain so that a small drive current will sustain the large current draw from the LEDs. A string of 35 zeros are sent on the data line every fifth update cycle. The driver has a serial input and does not have a master reset. This string of zeros resets the driver in case an extra pulse was entered by a noise spike. The basic circuit for one LED segment consists of the 5 Vdc LED supply (reduced to 4.3 Vdc by a series 1N4001 diode), a Darlington switch to enable the supply to the LED group, and the MM5451 driver to select a low voltage return for the segment (if selected).

1.6 Power Supply Board

1.6.1 Power Supply Board (6600-0330-700)

This is a functional description for the IWS Common Controller Power Supply Board which is used in all IWS models manufactured with Serial Number HCA and HCC. Refer to section 8 for a detailed circuit diagram.

The power supply board provides circuitry for control and monitoring of high voltage devices and for power to the control and display boards. The board is equipped with three jumpers that allow configuration for the common controller used with all units with Serial Number HCA and HCC, or for older model 5000 units. The jumpers are configured at the factory and should not be changed by field service personnel. Also found on the board is a line voltage sensing circuit that provides an indication of line voltage to the microcontroller.

The control circuits for the line voltage devices on the power supply board are functionally identical; they all require a TTL High signal from the control board to turn On the desired device. Line voltage devices are turned On using mechanical or solid state relays. Use of these devices allows high voltage control with commensurate high voltage/low voltage electrical isolation.

The heater is controlled from the power supply board by using a board mounted current source to drive a chassis mounted solid state relay. The heater circuit also contains a mechanical relay capable of removing power from the heater in the event of a system failure.

The regulator circuits provide a 5 Vdc supply to the display board in addition to 5Vdc and +9 Vdc to the control board. A NI-CAD battery supplies 9 Vdc and 5 Vdc standby power in the event of power loss. Standby power of 9 Vdc is used to activate the transducer alarm, while the 5 Vdc supply gives power to the microcontroller and associated integrated circuits.

5 Volt LEDS

A nominal voltage of 8 Vac is input to the power supply board at J11 pins 2 and 4. The line frequency is sent to the control board via J12 pin 2. The bridge rectifier CR2 and capacitor C11 provide filtered, unregulated 8 Vdc to the relays and the regulator. The 8 Vdc unregulated supply can be measured at TP-1. The unregulated supply must be a minimum of 6.8 Vdc for proper operation of the mechanical relay circuits.

The output of regulator VR2 is 5 Vdc nominally and supplies power to drive the LED displays on the display board. The output is measurable at J12 pin 12 or TP-10. When the supply voltage is within 10% from nominal, the output should range between 4.8 and 5.2 Vdc with a load of 500 ma. The maximum allowable ripple voltage is 150 mV.

Line Voltage Sensing

A nominal voltage of 11 Vac from the transformer secondary is input to the power supply board at J11 pins 1 and 2. Bridge rectifier CR1 and C12 provide a full wave, filtered voltage of 12 Vdc. At nominal line voltage, resistor R3 is adjusted to yield an output of 0.6 Vdc at J12 pin 11 or at TP-11. This voltage is then used by the microcontroller to compensate for fluctuations in line voltage.

9 Volt Standby

Variable resistor R4 adjusts the output of regulator VR3 to provide 9.6 ± 0.1 Vdc. This voltage charges the NI-CAD battery and supplies the input voltage to the 5 Vdc standby regulator.

5 Volt Standby

When line voltage is available, current flows from the output of VR3 and through CR5 to provide 9.0 ± 0.2 Vdc to the input of VR4. This voltage can also be found at J12 pin 3 and TP-12. Regulator VR4 outputs a voltage of 5.0 ± 0.2 Vdc to J12 pin 14 and TP-9 with a maximum ripple voltage of 150 mV.

When a line power loss occurs, the 7.2 Vdc NI-CAD battery maintains an output voltage to J12 pin 3, TP-12 and VR4. The output of VR4 maintains 5.0 ± 0.2 Vdc until the input voltage of VR4 drops below 7.0 Vdc. When the input voltage falls below this minimum, the regulator operates at a voltage not less than 2.0 Vdc below the input voltage.

Observation Light & Motor Control

The control circuits for the motor control (elevating bed option) and the observation light are identical. The observation light and motor are inductive loads, therefore, a snubber circuit has been placed in parallel with each load to protect the mechanical relay contacts from large voltage spikes.

The transistor in the control circuit is used as a switch and has active states of saturated (On) or unbiased (Off). When a relay should be turned On, a logic high signal ≥2.4 Vdc is output from the controller board to the control circuit.

This logic High signal on the base of the transistor saturates the transistor and allows current to flow through the pull-up resistor, the coil of the relay, and the collector-emitter junction of the transistor to ground. As current flows through the coil of the relay, the relay energizes and closes the relay contacts. Closure of the relay contacts allows current flow through the load. When a logic Low signal is output from the controller board, the transistor is in the unbiased state and no current flows through the relay coil. In the Off state, the relay contacts are Open and current does not flow through the load.

Alarm Lights

The alarm lights are controlled by logic level voltages output from the controller board which ultimately turn the solid state relay On and Off. The high voltage side of the circuit has a snubber and a varistor to protect the solid state relay from high voltage spikes. The older design (i.e. 6600-0181/183-700) does not have a varistor installed.

The transistor in the control circuit is used as a switch and has active states of saturated (On) or unbiased (Off). A logic High signal ≥2.4 Vdc is output from the controller board to the control circuit to turn the alarm lights On. This logic high signal on the base of the transistor saturates the transistor and allows current to flow through the pull-up resistor, the solid state relay, and the collector-emitter junction of the transistor to ground. The solid state relay performs in a way similar to a triac. Therefore, as a control voltage and current is presented to the low voltage side of the solid state relay, the internal isolator-driver turns On with sufficient current to close the triac gate and allow current to flow on the high voltage side of the solid state relay. When the high voltage side of the solid state relay is closed, current flows through the load and the alarm lights turn On. When a logic Low signal is output from the controller board, the transistor is in the unbiased state and no current flows through the control side and the corresponding high voltage side of the solid state relay.

Heater Status and Control

The heater circuitry consists of a monitoring circuit, a controller for the heater, and a mechanical safety relay to turn off the heater in the event of a system failure.

The full wave bridge rectifier CR6 takes the ac signal supplied to the heater and provides full wave dc to the opto-isolator U3. If the heater is active, a full wave dc signal turns On the LED at the forward bias voltage level. When the LED is On, the transistor goes into saturation, causing the output at J12 pin 1 to go Low (about 0.3 Vdc). When the full wave signal is in the region of zero potential, there is insufficient forward bias voltage for the LED, turning Off the transistor and allowing capacitor C10 to charge. When sufficient forward bias voltage is present during the next half-cycle, the capacitor discharges. The output waveform consists of discrete voltage spikes caused by the charging and discharging of the capacitor at every half cycle. If the heater is Off, the opto-isolator is Off, and presents a High level at J12 pin 1.

The heater control circuit uses a zero crossing opto-isolator triac driver to isolate the high and low voltage circuits. Operation of the heater control and other high voltage controls differ only in the use of the isolator and lack of a snubber circuit. When a logic High signal is present at the heater control circuit, the output of the isolator will not turn On until the ac signal of the heater crosses the zero potential from a negative voltage. After the input line from the microcontroller goes to a logic Low, heat will not turn Off until the first zero crossing preceded by the negative half cycle. This provides zero crossing control with 60 possible levels of heat. The time that the heater is On is dependent upon the line voltage and the percent heat desired (controllable in 5% increments).

Safety Relay

The safety relay circuit is used to turn Off the heater in the event of a failure which disallows heater control using the heater SSR. The transistor in the control circuit is used as a switch and has active states of saturated (On) or unbiased (Off). Under normal operating conditions, the safety relay is turned On during system boot when a logic high signal ≥2.4 Vdc is output from the controller board to the control circuit. This logic High signal on the base of the transistor saturates the transistor and allows current to flow through the pull-up resistor, the coil of the safety relay, and the collector-emitter junction of the transistor to ground. As current flows through the coil of the safety relay, the relay energizes and closes the relay contacts. Closure of the relay contacts allows current flow through the heater depending on the state of the heater SSR. When a logic Low signal is output from the controller board, the transistor is in the unbiased state and no current flows through the safety relay coil. In the Off state, the relay contacts are Open and current does not flow through the heater regardless of the state of the heater SSR.

Jumper & Test Point Description & Values

NOTE: Functions in italics indicate a signal present for common controller board configuration.

Connector	Signal Description	I/O Direction	Transition Threshold
J11-1	11 Vac secondary	–<	
J11-2	11 Vac secondary	–<	
J11-3	8 Vac secondary	–<	
J11-4	8 Vac secondary	–<	
J11-5	AUX 2 (power switch)	–<	
J11-6	AUX 1 (power switch)	–>	
J12-1	Heater status line	–>	heat Off V > 1.9 Vdc heat On V < 1.4 Vdc
J12-2	Line frequency	–>	
J12-3	+9 Standby power	–>	
J12-4	OBS light control V-High>2.4 Vdc	–<	V-Low <0.45 Vdc
J12-5	Raise bed control	–<	V-High>2.4 Vdc
J12-6	Lower bed control	–<	V-High>2.4 Vdc
J12-7	NC		
J12-8	Alarm light control	–<	V-High>2.4 Vdc
J12-9	Heater control	–<	V-High>2.4 Vdc
J12-10	Safety relay control	–<	
J12-11	Line voltage compensator	–>	
J12-12	+5 LED	–>	
J12-13	Display ground	–>	
J12-14	+5 Standby power	–>	
J12-15	NC		
J12-16	Ground		
J13-1	Neutral from breaker	–<	
J13-2	NC		
J13-3	Phase from breaker	–<	
J14-1	Neutral to heater SSR	–>	
	Phase to heater	–>	
J14-2	Heat detect	–>	
	Heater Neutral	–<	
J15-1	Transformer Neutral	–<	
J15-2	Neutral to obs light	–>	(switched)
J15-3	Phase to obs light	–>	
J16-1	Raise bed neutral	–>	(switched)
J16-2	Lower bed neutral	–>	(switched)
J16-3	Phase bed motor	–>	

NOTE: Functions in italics indicate a signal present for common controller board configuration.

I/O Connector	Transition Signal Description	Direction	Threshold
J17-1	Neutral to heater	–>	(switched)
	Heat detect	–<	
J17-2	Neutral alarm light	–>	(switched)
J17-3	Lamphouse Phase	–>	
	Alarm Phase	–>	
TP-1	8 Vac unregulated		
TP-2	NC		
TP-3	NC		
TP-4	NC		
TP-5	NC		
TP-6	NC		
TP-7	Control board ground		
TP-8	NC		
TP-9	+5.0 Vdc standby		5.0 ± 0.2 Vdc
TP-10	+5.0 Vdc LED supply		5.0 ± 0.2 Vdc
TP-11	Line voltage compensator		600mV at nom line in
TP-12	+9.0 Vdc standby		9.0 ± 0.2 Vdc
JP-1	Phase to safety relay (common controller)		
JP-2	Neutral to safety relay		
JP-3	Heat Detect to SSR/Heater (common controller)		
JP-4	Phase to Heat Detect		
JP-5	SSR to Neutral (common controller)		
JP-6	SSR to Heat Detect		

1.6.2 Power Supply Board (6600-0179-700)

This is a functional description for the IWS 2001/3000/3300/3500 Power Supply Board, used in units with the HAK serial numbers. Refer to Section 8 for a detailed circuit diagram.

The power supply board contains circuitry for the control and monitoring of voltage devices. The board also provides power to the control board and the display board. Also found on the board is a line voltage sensing circuit that provides an indication of line voltage to the microcontroller. The control circuits for each line voltage device on the power supply board are functionally identical with a logic High signal from the control board switching On the desired device. This is performed with an opto-isolator triac driver so low/line voltage circuits can interact but remain electrically isolated (2500 Vac dielectric). The heater is controlled from the supply board with an opto-isolator triac driver and triac. There is also a relay contact connected in series with the neutral to the heater triac. This is used to switch Off the heater if the heater triac fails or there is a failure on the control board. The regulator circuits provide a 5 Vdc supply to the display board, and 5 Vdc and 9 Vdc supplies to the control board. A NI-CAD battery supplies the 5 Vdc supply and a de-rated 9 Vdc supply for standby power, in the case of a power loss. Standby power of 9 Vdc is used to activate the transducer alarm, while the 5 Vdc supply provides power to the microcontroller and associated IC's for memory retention purposes.

5 Volt LEDS

A nominal 8 Vac is input to the power supply board at J11 pins 3 and 4. Theline frequency is also connected to the control board via J12 pin 2. The bridge rectifier CR2 and capacitor C11 provide a filtered unregulated 8 Vdc to the relay, opto-isolators, and the regulator VR12. The 8 Vdc unregulated supply can be measured at TP-1. The unregulated supply must be a minimum of 7.32 Vdc for proper operation of the relay circuit. The output of regulator VR2 is nominally 5 Vdc and supplies power to drive the LEDs on the display board. The output is measurable at J12 pin 12 (TP-10). When the supply voltage is within 10% of nominal, the output voltage should be between 4.8 and 5.2 Vdc with a maximum load of 500 ma. The maximum allowable ripple voltage is 150 mV.

Line Voltage Sensing

A voltage of approximately 11 Vac from the transformer secondary is input to the board at J11 pins 1 and 2. Bridge rectifier CR1 and capacitor C12 provide a full wave, filtered voltage of approximately 12 Vdc. Resistor R3 is preset to produce an output of approximately 0.6 Vdc at J12 pin 11 (TP-11) when the line voltage is at the nominal value for the unit. The analog voltage signal at J12 Pin 11 connects to the control board and is fed into the A/D Converter, ADC 3711 (U6), via the multiplexer, MC14051B (U-13). The digital output of the A/D converter is input to the microcontroller where the software then adjusts the power to the heater to compensate for variations in line voltage.

9 Volt Standby

The output of regulator VR3 is adjusted by R4 to provide 9.0 ± 0.2 Vdc (TP12). This voltage is used for charging the NI-CAD battery, and supplying the input voltage to the 5 standby regulator.

5 Volt Standby

When line voltage is available, current flows from the output of VR3 and through CR5 to provide 9.0 ± 0.2 Vdc to the input of VR4, and to J12 pin 3 (TP-12). In turn, regulator VR4 outputs a voltage of 5.0 ± 0.2 Vdc to J12 pin 14 (TP-9) with a maximum ripple voltage of 150 mV. If power loss occurs with the unit switched On, the 7.2 Vdc NI-CAD battery maintains a de-rated output voltage of approximately 6.5 Vdc to pin 3 of J12 (TP-12). It also provides input to VR4. The output of VR4 only regulates to approximately 5.0 Vdc as the input voltage drops below 7.0 Vdc.

Observation Light and Alarm Lights

The control circuits for the observation light, and the alarm light are similar. The alarm light is a resistive load and does not have a snubber circuit in parallel with the load. The snubber circuit on the observation light supply protects the triac from large voltage spikes characteristic of inductive loads. If the control lines are logic Low, less than 0.45 Vdc, this keeps the Darlington switch, triac driver, and triac switched “Off”. The triac acts as a switch to the line voltage circuit, removing voltage from the load. When a device should be switched On, a logic High of 2.4 Vdc minimum is output to the corresponding Darlington switch. The Darlington switch switches On causing the LED of the isolator-driver to switch On. The isolator/ driver output drives sufficient current to the triac gate, switching the triac On allowing the selected device to switch On.

Heater Status and Control

The heater circuitry consists of a monitoring circuit, a controller for the heater, and a relay to switch Off the heater in the event of a triac or system failure. The full wave bridge rectifier CR6 takes a sample (through R13) of the ac signal supplied to the heater and provides rectified dc to the opto-isolator U3. If the heater is On the dc output switches On the LED in the opto-isolator, except at voltage levels below the forward bias voltage. When the LED is On the transistor goes into saturation causing the output at J12 pin 1 to go Low (about 0.3 Vdc). When the heater is Off the dc signal is in the region of zero potential and there is insufficient forward bias voltage for the LED. This switches Off the transistor allowing capacitor C10 to charge causing J12 pin 1 to go high (5 Vdc). When the heater is switched On the LED switches the transistor On again, and the capacitor discharges. The Low output shows small glitches caused by the charge/discharge of the capacitor at every half cycle. The glitches are acceptable provided they do not exceed the trigger voltage of 1.4 Vdc for the 74LS132 on the Control Board.

The heater control circuit uses a zero crossing opto-isolator triac driver to isolate the line voltage from the low voltage circuits. Operation of the heater control and other line voltage controls differ only in the type of isolator used and the use of snubber circuits. When a logic High signal is sent to the heater control circuit from J12 pin 9 the output of the isolator will not switch On until the ac signal of the heater crosses the zero potential from a negative voltage. After the input line from the microcontroller goes Low, heat will not switch Off until the first zero crossing preceded by the negative half cycle. This provides zero crossing control of the heater switching. The time that the heater is On depends on the percent heat desired (controllable in 5% increments). The microcontroller also monitors the line voltage and adjusts the number of ac cycles that the heater is switched On. This provides heater compensation. If the line voltage is not at the nominal value, these two functions result in 60 levels of heat.

Relay

The relay circuit is used to switch Off the heater in the event of a triac or microcontroller failure. Under normal conditions the input line from J12 pin 10 is a logic High, 2.4 Vdc minimum. A logic High signal on the input from the control board switches On the Darlington switch causing the relay coil to energize and close the switch. If the Darlington switch input is a Low from the control board (0.5 Vdc max.), the Darlington switch switches Off and the relay contacts Open. The signal at J12 pin 10 comes from U1 on the control board which is a part of a logic/timing circuit independent of the microcontroller. A minimum voltage of 7.2 Vdc is required to energize the relay coil. Therefore the minimum allowable voltage for the 8 Vdc unregulated supply is 7.32 Vdc since the Darlington switch has an internal voltage drop of 0.12 Vdc.

1.6.3 Power Supply Board (6600-0181/183-700)

This is a functional description for the Infant Warmer System Model 5000, 115 Vac and 220/240 Vac Power Supply Boards used in units with the AAN serial number. Refer to Section 8 for a detailed circuit diagram.

The power supply board contains circuitry for the control and monitoring of line voltage devices. The board also provides power to the control board and the display board. Also found on the board is a line voltage sensing circuit that indicates line voltage magnitude to the microcontroller.

The control circuits for each line voltage device on the power supply board are functionally identical, with a logic High signal from the control board switching On the desired device. This is performed with an isolator so low/line voltage circuits can interact but remain electrically isolated (2500 volt dielectric).

The heater is controlled from the supply board with a solid state relay switching line voltage. There is also an electro-mechanical relay contact connected in series with the neutral to the solid state relay. This is used to switch Off the heater if the solid state relay fails or there is a failure on the control board.

The regulator circuits provide a 5 Vdc supply to the display board, and5 Vdc and 9 Vdc supplies to the control board. A NI-CAD battery supplies the 5 Vdc supply, and a de-rated 9 Vdc supply for standby power, in the case of a power loss. Standby power of 9 Vdc is used to activate the transducer alarm, while the 5 Vdc supply provides power to the microcontroller and associated IC's for memory retention purposes.

5 Volt LEDS

A nominal 8 Vac is input to the power supply board at J11 pins 3 and 4. The line frequency is also connected to the control board via J12 pin 2. The bridge rectifier CR2 and capacitor C11 provide a filtered unregulated 8 Vdc to the relay, opto-isolators, and the regulator VR2. The 8 Vdc unregulated supply can be measured at TP-1. The unregulated supply must be a minimum of 7.32 Vdc for proper operation of the relay circuit.

The output of regulator VR2 is nominally 5 Vdc and supplies power to drive the LED displays on the display board. The output is measurable at TP-10 (J12, Pin 12). When the supply voltage is within 10% of nominal, the output voltage should be between 4.8 and 5.2 Vdc with a maximum load of 500 ma. The maximum allowable ripple voltage is 150 mV.

Line Voltage Sensing

A voltage of approximately 11 Vac from the transformer secondary is input to the board at J11 pins 1 and 2. Bridge rectifier CR1 and capacitor C12 provide a full wave, filtered voltage of approximately 12 Vdc. Variable resistor R3 is preset to produce an output of approximately 0.6 Vdc at J12 pin 11 (TP-11) when the line voltage is at the nominal value for the unit. The analog voltage signal at J12 Pin 11 connects to the control board and is fed into the A/D Converter, ADC 3711 (U6), via the multiplexer, MC14051B (U-13). The digital output of the A/D converter is input to the microcontroller where the measured value determines the duration of power pulses to the heater to compensate for variations in line voltage.

9 Volt Standby

The output of regulator VR3 is adjusted by R4 to provide 9.0 ± 0.2 Vdc (TP12). This voltage is used for charging the NI-CAD battery, and supplying the input voltage to the 5 Vdc standby regulator.

5 Volt Standby

When line voltage is available, current flows from the output of VR3 and through CR5 to provide 9.0 ± 0.2 Vdc to the input of VR4, and to J12 pin 3 (TP-12). In turn, regulator VR4 outputs a voltage of 5.0 ± 0.2 Vdc to J12 pin 14 (TP-9) with a maximum ripple voltage of 150 mV.

If power loss occurs while the unit switched On, the 7.2 Vdc NI-CAD battery maintains a derated output voltage of approximately 6.5 Vdc to pin 3 of J12 (TP-12). It also provides input to VR4.

Note: The output of VR4 only regulates to approximately 5.0 Vdc as the input voltage drops below 7.0 Vdc.

Heater Control and Status

The heater circuitry consists of a controller for the heater, a monitoring circuit, and a relay to switch Off the heater in the event of a relay or system failure.

The heater control circuit uses a solid state relay to isolate the line voltage from the low voltage circuits. Operation of the heater control and other line voltage controls differ only in the type of isolator used and the use of snubber circuits. When a logic High signal is sent to the heater control circuit from J12 pin 9 the output of the solid state relay will not switch On until the ac signal of the heater crosses the zero potential from a negative voltage. After the input line from the microcontroller goes Low, heat will not switch Off until the first zero crossing preceded by the negative half cycle. This provides zero voltage crossing control of the heater switching. The time that the heater is On depends on the percent heat desired (controllable in 5% increments).

The microcontroller also monitors the line voltage and adjusts the number of ac cycles that the heater is switched On. This provides heater power compensation. If the line voltage is not at the nominal value, the combination of percentage power settings and power compensation can produce 60 durations of heater power pulses.

The full wave bridge rectifier CR6 takes a low voltage sample (through R13) of the ac signal supplied to the heater and provides rectified dc to the opto-isolator U3. If the heater is On the dc output switches On the LED in the opto-isolator, except at voltage levels below the forward bias voltage. When the LED is On the transistor goes into saturation causing the output at J12 pin 1 to go Low (about 0.3 Vdc). When the heater is Off the dc bridge output is in the region of zero potential and there is insufficient forward bias voltage for the LED. This switches Off the transistor allowing capacitor C10 to charge and causes J12 pin 1 to go high (5 Vdc). When the heater is switched On the LED switches the transistor On again, and the capacitor discharges. The low output shows small glitches caused by the charge/discharge of the capacitor at every half cycle. The glitches are acceptable provided they do not exceed the trigger voltage of 1.4 Vdc for the 74LS132 on the Control Board.

Relay

The relay circuit is used to switch Off the heater in the event of a triac or microcontroller failure. Under normal conditions the input line from J12 pin 10 is a logic High, 2.4 Vdc minimum. A logic High signal on the input from the control board switches On the FET causing the relay coil to energize and close the relay contacts. If the FET input is a Low from the control board, (0.5 Vdc max.) the FET switches Off and the relay contacts Open. The signal at J12 pin 10 comes from U1 on the control board which is a part of a logic/timing circuit independent of the microcontroller.

A minimum voltage of 7.2 Vdc is required to energize the relay coil. Therefore the minimum allowable voltage for the 8 Vdc unregulated supply is 7.32 Vdc, since the FET has an internal voltage drop of 0.12 Vdc.

Units with AAN Serial No.

Motor Up/Down Control

The bed up/down movement is controlled by separate raise bed or lower bed signals. When the raise bed or lower bed switch is selected, the logic High control signal (J12 pin 5 for raise and J12 pin 6 for lower) is buffered by an FET (U2 pin 5 for raise, U2 pin 3 for lower) which powers an opto-isolator. The output of the opto-isolator (U6 for raise, U5 for lower) triggers the triac gate (Q4 for raise, Q3 for lower) which then switches the neutral supply for the motor. The motor is a combination inductive, capacitive and resistive load which requires a snubber network to minimize switching noise. This is achieved by R21/C17 for raise bed and R18/C16 for lower bed signals.

Note: When the bed is raised or lowered the heater control signal is inhibited, stopping heater power to minimize the units total current until the movement is completed.

Alarm Light Control

The alarm lights are controlled by a triac switching line voltage to the lamps. If the control lines are logic Low (less than 0.45 Vdc) the FET, triac driver, and triac remain switched Off. The triac acts as a switch to the line voltage circuit, removing voltage from the load.

When the lamps should be switched On, a logic High of 2.4 Vdc minimum is output to the corresponding U1, Pin 10 FET. The FET switches On, causing the LED of the isolator-driver (U8) to switch On. The isolator/driver output drives sufficient current to the triac gate, switching the triac (Q5) On, allowing the alarm lights to switch On. The alarm light is a resistive load and does not have a snubber circuit in parallel.

Observation Lamp Control

The observation lamp is controlled by a relay which switches line voltage to a transformer outputting 12 Vac to the lamp. The FET U1 pin 5 buffers the microcontroller signal and switches the control relay. The 12 Vac powers the observation lamp which is rated at 12 Volts, 50 watts.

Software revision 04.01 and higher

1.7 ThermaLink Communication Option

The ThermaLink communications option allows direct output of serial data to various remote monitoring systems, such as a computer or commercial RS-232 monitor. This option is available on IWS models with software revision 5.00 or higher. Units with 4.01 software will require installation of 5.00 software, order kit no. 6600-0002-850 (Some 4.01 units have no J-9 connector, and will require a new control board). Units prior to 4.01 software will require installation of the EMI Noise Suppression Kit (see section 1.2), which includes 5.00 software.

Older Communication Board with Test Switch

The ThermaLink option board contains the electronic circuity necessary to provide a 2500 VRMS isolated serial interface to meet the logic levels specified by EIA RS-232D and CCITTV.28. Refer to section 8 for a detailed circuit diagram.

The MAX250 and MAX251 (Ul and U2), together with two 6N136 opto-couplers and transformer TRI, form an isolated RS-232 transmitter and receiver. The MAX250 connects to the non-isolated or “logic” side of the interface, translating logic signals to and from the opto-couplers, while the MAX251 resides on the isolated or “cable” side, translating data between the opto-couplers and RS-232 line drivers and receivers. In addition to the opto-coupler drivers and receivers, the MAX250 also contains isolation transformer drive circuitry which supplies power to the isolated side of the interface, and the MAX251.

The transmit signal is input to the MAX250 driver (Ul pin 4) whose output (Ul pin 3) drives opto-coupler U4. The opto-coupler output (U4 pin 6) is then fed into the MAX251 driver (U2 pin 3).

The output of the MAX251 driver (U2 pin 12) is at the logic levels conforming to EIA RS-232D and CCITTV.28.

Conversely, the receive signal enters the MAX251 driver (U2 pin 10) and is stepped down to CMOS/TTL levels at U2 pin 5. This logic level drives optoisolator input (U3 pin 3) whose output is fed into U1 pin 10. The output (U1 pin 9) signal is then available to the control printed circuit board.

A slide switch SW1 is used as a “self test” for the RS-232 interface. In the closed position, the J30-1 transmit signal is sent through the MAX250/MAX251 transmitter and back into the receiver portions. The signal can be read at J30-2 and verified to be correct. Any external cable connection must be removed for this self test to function. CR1 and CR2 provide transient protection for MAX251. In normal operation SW1 should be in the open (OFF) position.

The nurse call signal is input at J30-5 as a TTL logic level. In the “no alarm” state, this signal is a logic high, which turns on Darlington Q1, energizing relay K1. This results in contact closure between J31-1 and J31-2. In the “alarm” state, J30-5 is a logic low, which turns off Q1, de-energizes K1 and results in contact closure between J31-2 and J31-3. K1 provides 2500 VRMS isolation between the relay coil inputs and contact outputs.

Newer communication boards without test switch

The Communication Board contains the electronic circuitry necessary to provide a 2500 VRMS isolated serial interface to meet the logic level specified by EIA RS-232E and CCITTV.28.

Data and power from the main control board enter the communication board via connector JP2. Data from the control board is connected to Port P1.0 and INTO (pin 2 and 14 respectively) of microcontroller U1. Data from the control board will create an interrupt in the microcontroller’s software, causing the software to perform a read of Port P1.0. Data to the control board is sent by Port P1.1 (pin 3) of microcontroller U1. The software is coded to properly format the data sent to the main control board. The format data to and from the control board is 1 start bit, 7 data bits (ASCII), 1 parity bit (odd), 1 stop bit, 1200 baud, full duplex.

The data translation is performed by the microcontroller. The microcontroller monitors the incoming signals from the RS232 interface. Based upon the signal entering the interface, the microcontroller determines the type of communication system connected to the interface. The microcontroller then appropriately converts the data to the proper format.

RS232 data to and from the microcontroller is sent via the serial port, RXD and TXD (pin 11 and 13 respectively). The serial port is full duplex, meaning it can transmit and receive data simultaneously. The remaining output line (WR) is for future expansion and is not currently used.

Components Y1, C1, and C2 make up the oscillator circuitry for the microcontroller. The crystal is operated as an inductive reactance in parallel resonance with capacitors C1 and C2. The oscillating frequency is 11.0592 Mhz.

Capacitor C5 is used to ensure proper reset of the microcontroller during power up. An internal diffused resistor is connected between the reset pin and Vss. C5 and the internal resistor causes the reset of the microcontroller to be held high for greater than 24 machine cycles.

Capacitors C6, C7, C11, and C12 are used to suppress any noise on the data lines or +5V line.

The MAX250 and MAX251 together with three 6N136 optocouplers and a transformer, form an isolated RS-232 transmitters and receiver. The MAX250 is located on the non-isolated side of the communication board. The MAX250 translates the logic signals between the microcontroller and the optocouplers. The MAX250 also contains drive circuitry for the isolation transformer, which supplies power to the isolated side of the interface. The MAX250 alternately switches D1 and D2 to ground at a rate of approximately 200 Khz.

The MAX251 resides on the isolated side of the communication board. The MAX251 translates data between the optocouplers and the RS-232 interface. The MAX251 contains drivers and receivers that conform to EIA RS-232E and CCITT V.28 specifications.

Diode D1 and an internal diode in the MAX251 form two half wave rectifiers. The anode of the internal diode is connected to pin 1 and the cathode is connected to pin 2. The internal diode and capacitor C4 are utilized for the positive power supply. Diode D1 and capacitor C3 are utilized for the negative power supply.

Pin 7 of the MAX251 supplies an output of approximately 5 volts. Capacitor C9 provides filtering for the line. This voltage is used to bias the output stage of optocouplers ISO1 and ISO2. The output stage of ISO3 is biased by the 5V supply from the main control board. Resistors R1, R2, and R5 are pull up resistors for the collector of the output transistors.

The RS232 output pins 11 and 12 will provide a minimum voltage swing of ±5 volts. Resistors R3 and R4 limit the amount of current. The RS232 input pin 10 can have a maximum of +30 volts to -30 volts applied. Recommended input voltage should be +15 volts to -15 volts.

Inductors L1, L2, and L3 and capacitors C10, C13, and C14 are used to suppress any high frequency noise on the data lines. Diodes D2, D3, and D4 are bi-directional transient voltage suppressors. The diodes will limit the incoming voltage to approximately ± 26 volts.

The nurse call signal from the main control board is connected to the communication board at JP2-5. The signal is a TTL logic level. In the “no alarm” state, this signal is a logic high. A logic high turns on darlington transistor Q1, which causes relay K1 to energize. This results in contact closure between JP1-1 and JP1-2. In the “alarm” state, the incoming logic level is low. A logic low turns off darlington transistor Q1, which denergizes relay K1. This results in contact closure between JP1-1 and JP1-8. Resistor R6 limits the current into the transistor. Capacitor C15 suppresses noise on the control line. Diode D5 shorts the back EMF from the coil of the relay when de-energized.

2.1 Setup

After removal from the shipping containers, inspect the Ohio Infant Warmer System and all accessory items for any signs of damage that may have occurred during shipment. File a damage claim with the shipping carrier if damage has occurred. Also confirm the presence of all accessory items or factory installed options as listed on the packing slip.

For Model 3050,3100 and 3150 wall mounted units, refer to the mounting instructions included in the Appendix.

2.2 Checkout Procedure

WARNINGS

⚠ Do not perform the Checkout Procedure (Mechanical and Control Unit) while a patient occupies the warmer.

⚠ Perform this Checkout Procedure after servicing the warmer. Complete the Checkout in the Operation and Maintenance Manual before placing a patient in the Infant Warmer and between each use. If the unit fails any steps of the Checkout Procedure it must be removed from service and repaired.

Refer to the Troubleshooting Guide and the Disassembly and Repair Sections of this Service Manual. If an error code appears in the elapsed time display, refer to Section 6.3, Troubleshooting Error Codes. Refer servicing to qualified service personnel if the unit does not perform as specified.

2.2.1 Mechanical Checkout Procedure

A. Overall Appearance

1. Disconnect the power cord from the AC power source for the mechanical checks portion of this procedure.

2. Check the overall appearance of the warmer/bassinet system. There should be no obvious damage.

3. For the model 3500, separate the warmer from the bassinet.

4. For units with casters, check that all four casters are in firm contact with the floor and that the Infant Warmer moves freely.

   For the model 3500, check that all six casters on the warmer move freely.

   Note: On the 3500, it is possible that the two center casters may not be in contact with the floor at all times.

5. Lock the two front casters and check that the warmer is held in place. On the 3500, lock the two rear casters and check that the warmer is held in place.

6. Examine the power cord for damage. Examine the power plug for loose or bent pins. Replace the power cord if the cord or plug is damaged.

CAUTION ⚠ Insulation on electrical wiring deteriorates with age. Check for brittle or deteriorated insulation on power cord and all other electrical wiring.

7. For the model 3500, place the bassinet on a level surface. Check that all four casters are in firm contact with the floor and that the bassinet moves freely.

8. For the model 3500, lock the two front casters and check that the bassinet is held in place.

9. Examine the unit for objects placed on top of the heater assembly.

WARNINGS ⚠ Do not place any accessories or other objects directly over the bed surface. This may block radiant energy and lead to cooling of the infant.

⚠ Do not place items on top of the heater assembly. Items placed on top of the heater assembly can fall and injure the patient, and prevent adequate ventilation of the heater assembly.

B. Heater Rotation

Rotate the heater to the side and then back to the normal position. Check for smooth rotation.

C. Mechanical Checks

1. Check the operation of the bed sides. The bed sides should operate smoothly and lock securely in place.

   For the model 3500:

   a. Unlock the ends by sliding the latch buttons outward to expose the red dots.

   b. Check that the bed sides lower and raise smoothly.

   c. Check that the ends lock by sliding the latch buttons to cover the red dots.

WARNING ⚠ Regularly inspect the bed side panel latching mechanism, and the bedside locking mechanism on the model 3500, to ensure proper operation.

2. Check the operation of the tilt mechanism. Verify that the bed platform operates smoothly and locks in normal, Trendelenburg and Fowler positions.

3. If the drawer package is installed, check that the drawers open and close freely.

   On units with the rotating drawer package, push the corner and insure the drawer package moves freely left and right 90° and then seats in the detent position.

WARNING ⚠ Overloading the drawers can affect the stability of the unit. Limit the load to 10 lbs. (4.6 kg) per drawer, 20 lbs. (9 kg) per deep drawer.

4. For the model 3500 bassinet, remove the keys from the top drawer and lock it. Check that the drawer is securely held closed.

D. Warmer/Bassinet Interlock (model 3500 Only)

1. Lock the 3500 warmer's two rear casters.
2. Align the bassinet with the warmer .
3. Push the bassinet over the alignment/locking track of the warmer.
4. Continue pushing the bassinet until its locking pin drops into the socket at the end of the alignment track. There should be an audible click when the pin drops into position.
5. Lightly push and pull the bassinet to verify that the two units are securely held together.
6. Unlock the two rear casters on the warmer and check that the combined unit moves smoothly.

E. Warmer/Bassinet Unlock (Model 3500 Only)

1. Verify that the two bassinet front casters are unlocked.
2. With the locking pin handle (located at the rear of the bassinet) raised, pull the bassinet forward until it is fully detached from the warmer.

CAUTION ⚠ To prevent the drawers from opening unintentionally while moving the detached bassinet, move it from the front only.

F. Accessory Checks

Perform these checks if they are applicable.

1. Check that all accessories are mounted securely and that the load limits are not exceeded.
2. Check that all gas accessories are installed and operating properly. Check that the cylinders are mounted securely. Perform the leak check in section 5.8F.

   Check the output from the regulator(s) (refer to Section 4.4.)
3. If an Ohmeda airway manometer will be used, verify that it reads 0 Kpa at atmospheric pressure. If it is necessary to zero the manometer, unscrew the plastic bezel. Turn the screw located below the 4 Kpa mark on the dial face until the needle reaches zero. It may be necessary to loosen the two lower adjustment screws, adjust the needle by turning the upper screw, and re-tighten the two lower screws. A final fine adjustment may be necessary after the two lower screws are tightened. Be sure the lower screws are tight before using the manometer. Replace the bezel. Check that the manometer registers positive and negative pressures, and is not damaged or loose.

4. Where applicable, perform the checkout procedures detailed in the Operation and Maintenance Manuals for the accessories.

WARNINGS

⚠ Overloading the shelves can affect the stability of the unit. Limit the load to 20 lbs. (9 kg) per instrument shelf, mounted to a single upright, and 50 lbs (23 kg) per monitor shelf, mounted between the uprights.

⚠ Limit the load of accessories to 50 lbs. (23 kg) per side of the infant warmer. Always try to evenly distribute the weight of accessories on both sides of the unit for a more balanced load. Accessories should not be mounted more than 56 inches (142cm) above the floor. For models 3000 and 3500, limit the load of accessories to 20 pounds (9kg) maximum per side mounted no more than 44 inches (112cm) above the floor.

⚠ Due to the increased height of units with the ECMO option installed, a tipping hazard exists. Limit the total load of accessories to 50 lbs. (23 kg), no more than 25 lbs. (11 kg) per side of the infant warmer.

G. Wall Mount Check Out Models 3050, 3100 and 3150

1. Verify that the heater assembly is rigidly secured to the wall and is level.

   Note: To access the control unit and display module for service procedures, hinge pins may be removed on one side or the other, allowing the warmer to pivot away from the wall to the service position.

2. Check that all hinge pins are in place and fully inserted with the pin heads at the top of the hinge.

WARNING

⚠ In the service position, never place a patient in the bed when the heater is in the service position. Never leave the unit unattended in the service position or with either pin removed.

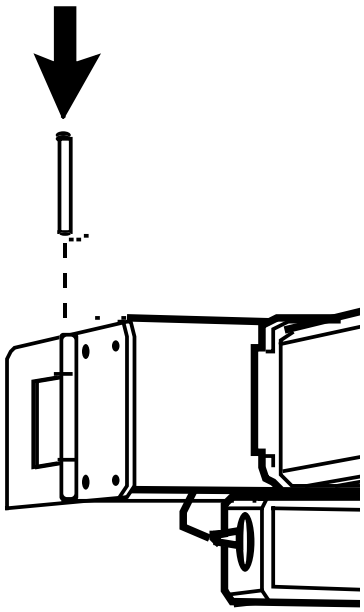

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Figure 2-1
Wall mount pin insertion

2.2.2 Control Unit Checkout Procedure

A. Control Unit Check

1. Connect the Infant Warmer power cord to an appropriate power source. Refer to the rating plate on the Warmer System for the proper voltage needed. Switch the power On and verify the following on the Control Panel (Figure 2-2):
   a. The alternating two tone audible alarm sounds and all displays and indicators are lit for approximately two seconds.
   b. The software version appears in the elapsed time display.

      Note: During this time the controller also performs self check functions. If the controller detects a failure, the alarm stays on and service is required.

      Note: On units with HCA and HCC serial numbers, all alarms except system failure or powerfailure are preceded by a 30 second intermittent operator prompt tone.
   c. The manual mode indicator is lit.

      Note: The IWS 2001 International does not have a manual mode indicator.
   d. Operator prompt tones sound and the % power display flashes.

2. Adjust the heat output with the increase (▲) and decrease (▼) touch switches to attain the high and low limits as indicated by the % power display.

   Note: Steps 3 through 8 do not apply to the model 2001 international.

3. Connect the skin temperature probe to the warmer.

4. Press the mode switch to place the warmer in the servo mode and verify the following:

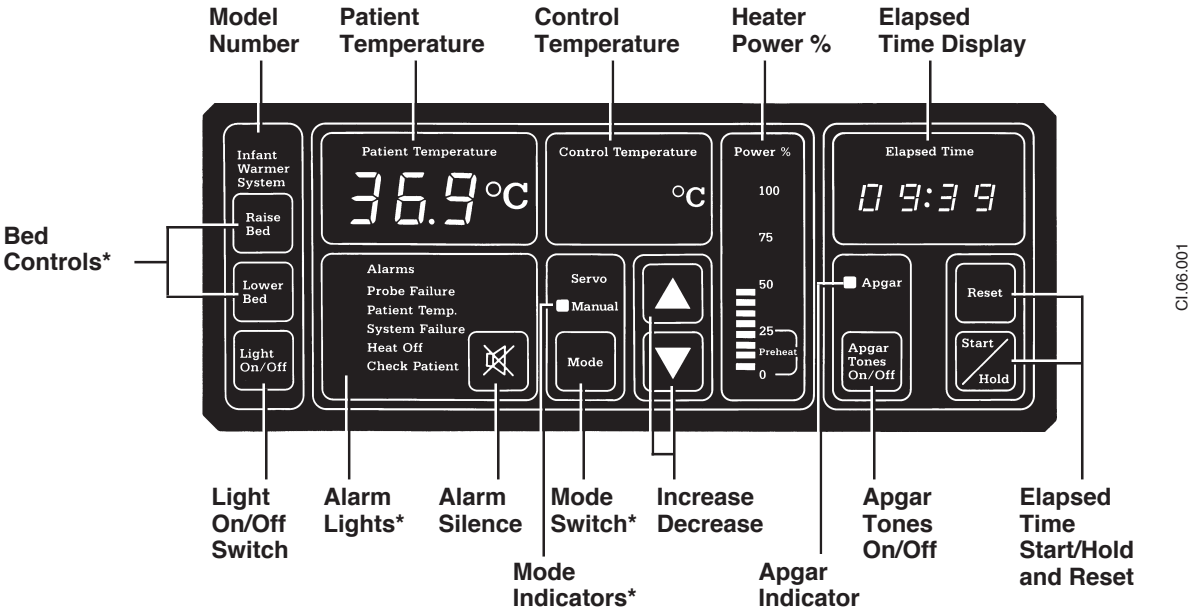
   Note: An alternating two tone alarm, a flashing overhead alarm light and the patient temperature display flashing “LL.L” or “HH.H” may occur here if the skin temperature probe is below 22°C. Warm the probe with your fingers or silence the alarm.
   a. The servo mode indicator is lit.
   b. An operator prompt tone sounds and the control temperature display flashes 36.5°C.

5. Press the increase (▲) touch switch and verify that the maximum servo control temperature attainable is 37.5°C.

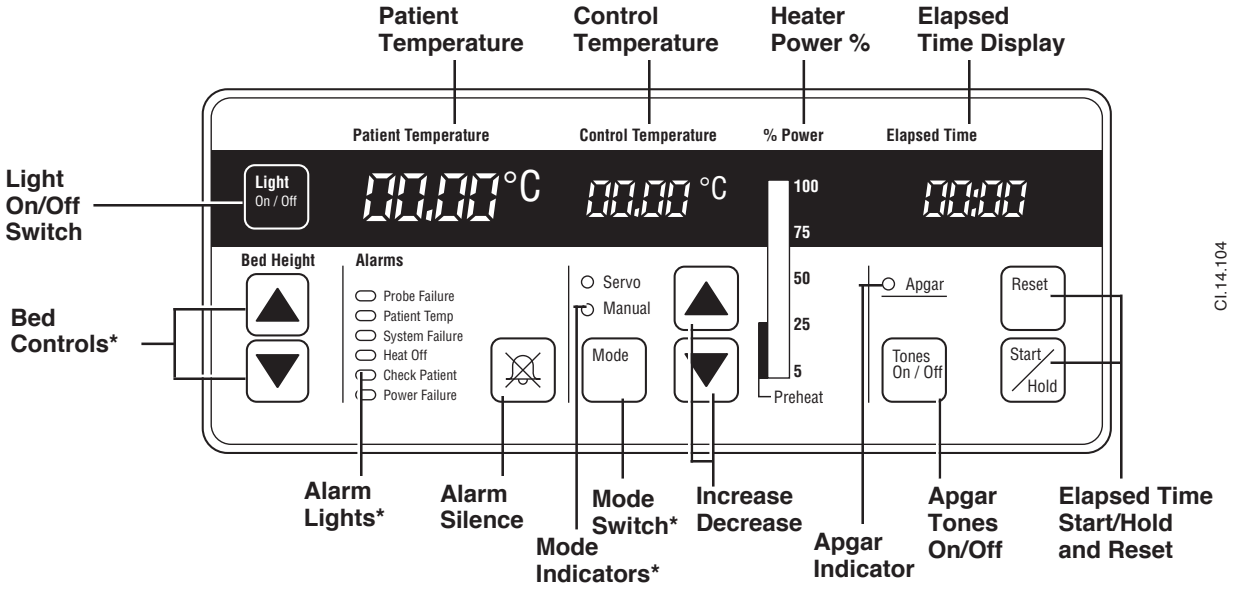
   Note: A patient temperature alarm occurs if the difference between the patient temperature and the control temperature is greater than 1°C (the alarm can be adjusted to 0.5°C by a qualified service person. Refer to Section 3.2, Changing the Patient Temperature Alarm Limits, for details).

6. Press the decrease (▼) touch switch and verify that the minimum servo control temperature attainable is 35.0°C.

Units with AAN, HAJ, HAK and HCA Serial Numbers



Units With HCC Serial Numbers



* Servo mode indicator, mode switch, and probe failure alarm are not present on the model 2001 international control panel. Bed raise/lower only present on elevating models.

Figure 2-2
Typical Infant Warmer System Control and Display Panel

7. Disconnect the skin temperature probe. Verify the following:
   a. The probe failure indicator light is lit.
   b. There is alternating two tone alarm.
   c. The overhead alarm light is lit.
   d. The patient temperature display flashes “HH.H”.

8. Press the alarm silence switch and verify the following:
   a. The probe failure indicator light is lit.
   b. The audible alarm is silenced.
   c. The overhead alarm light is lit.
   d. The patient temperature display indicates “HH.H”.
   e. After one minute, the alternating two tone alarm sounds, the overhead alarm flashes and the patient temperature display flashes “HH.H”.
9. Switch to the manual mode and set the heat at 25% power.

B. Elapsed Timer Check

1. Press the Start/Hold touch switch to activate the elapsed timer. Verify that the timer starts operating.
2. Press the On/Off touch switch for the Apgar tones. Verify that the indicator light for the Apgar tones is extinguished.
3. Press the On/Off touch switch for the Apgar tones again. Verify that the indicator light for the Apgar tones is lit.
4. Press the Start/Hold touch switch. Verify that the present elapsed time is held.
5. Press the Start/Hold touch switch and verify that the timer updates to the current elapsed time and the Apgar tones continue to sound at the specified times (at 1 minute and at every 5 minute interval after the elapsed timer has started).
6. Press the Reset touch switch and verify that the timer indicates “00:00”. If the elapsed timer is not used for approximately two minutes, the display switches off.

C. Observation Light Check

Press the Light On/Off touch switch. Verify that the observation light functions.

D. Raise and Lower Bed Switch Check (Elevating Models Only)

CAUTION

⚠ Do not continue to run the motor at the upper and lower limit positions; equipment damage may result.

1. Press the raise bed touch switch on the display and verify that the bed raises to a maximum of 46 1/2 inches (118 cm) off the floor.
2. Press the lower bed touch switch on the display and verify that the bed lowers to a minimum of 38 1/2 inches (98 cm) off the floor.
3. Verify that either foot switch (if present) raises and lowers the bed.

E. Interlock Switch Check

1. Place the Infant Warmer in the manual mode at 25% power output.

2. Rotate the heater assembly 90° to the side. Verify that the heater Off indicator light is On and the % power display indicates 0% heat.

3. Rotate the heater assembly to the normal operating position. Verify that the heat Off indicator light is Off and the % power display indicates 25%.

F. Power Failure, Memory Test and Battery Test

(For model 2001 international see next page)

1. Operate the unit in the manual mode with the heat set in the “pre-heat” range for a minimum of one hour to charge the battery.

Note: The battery must be fully charged to pass the ten minute test or partially charged to pass the two minute test. If the battery is defective, replace it with an Ohmeda NI-CAD rechargeable battery. There is no maintenance required for the battery. The battery has a two year replacement schedule.

CAUTION ⚠ Replace only with Ohmeda NI-CAD rechargeable Battery.

2. Disconnect the patient temperature probe.

3. Place the warmer in the servo mode.

4. Silence the probe failure alarm.

5. Set the control temperature at 37.0°C.

6. Remove the warmer power plug from the power source for two minutes. Do not switch the power Off. The power failure alarm should sound for two minutes and the power failure indicator (if present) should light.

   Note: If the power failure alarm is tested for ten minutes, the warmer must be connected to the correct power source and operated in the manual mode at the 0% heat setting for 24 hours to recharge the battery before allowing a patient to occupy the warmer.

   Note: The power failure alarm will not operate if the circuit breaker trips.

7. Reconnect the warmer to the power source. Verify the following:
   a. The warmer is operating in the servo mode.
   b. The control temperature is 37.0°C.
   c. The audio power failure alarm is Off.

Power Failure, Memory and Battery test for 2001 International model

1. Select 25% heater power.
2. Remove the warmer power plug from the power source for two minutes. Do not switch the power OFF. The power failure alarm should sound for two minutes, and the power failure indicator (if present) should light.
3. Reconnect the warmer to the power source and verify the following:
   a. The heater is operating at 25% power.
   b. The audio power failure alarm is off.

G. Calibration Check

1. Press and hold the Start/Hold touch switch for five seconds. On units prior to software revision level 4.01, press and hold the hidden switch on the control panel located directly above the alarm silence switch for two seconds.
2. Check the values in the display fields:
   a. The patient temperature reads 25.0 ± 0.3°C.
   b. The control temperature reads 37.9 ± 0.3°C

      Note: IWS 2001 International units do not have a control temperature display.

   c. The elapsed time display reads ten times % nominal line voltage ± 2%.

      Note: Measure the outlet voltage and read the corresponding percent of your unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage sets the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage is 95% and 950 ± 20 will appear in the elapsed time display.

Line (Outlet) Voltage			% Nom. Line	
95V Nom.	115V Nom.	220V Nom.	230/240V Nom.	Voltage x10 (Elapsed time display)
86	104	199	217	900 ± 20
87	105	201	219	910 ± 20
88	106	203	221	920 ± 20
89	107	205	224	930 ± 20
90	109	207	226	940 ± 20
91	110	210	229	950 ± 20
92	111	212	231	960 ± 20
93	112	214	233	970 ± 20
94	113	216	236	980 ± 20
95	114	218	238	990 ± 20
95	115	220	240	1000 ± 20
96	117	223	243	1010 ± 20
97	118	225	245	1020 ± 20
98	119	227	248	1030 ± 20
99	120	229	250	1040 ± 20
100	121	232	253	1050 ± 20
101	122	234	255	1060 ± 20
102	124	236	257	1070 ± 20
103	125	238	260	1080 ± 20
104	126	240	262	1090 ± 20
105	127	243	265	1100 ± 20

3.‡ Check the RS-232 circuitry. Short pins 2 and 3 of the RS-232/Nurse Call connector. Press the Apgar Tones switch while powering up the unit. Release the switch when a continuous alarm sounds. If the RS-232 option is functioning, the temperature displays will cycle to a frame that shows “rs 232 PASS”.* Conversely, if the RS-232 circuitry is not functioning or is not installed, the temperature displays will cycle to frame that shows “rs 232 FAIL”. Turn off the unit to exit this test mode. Remove short from pins 2 and 3.

4.‡ Check the Nurse Call circuitry by rotating the heater to the X-ray position to trigger a heater off alarm. Under the “no alarm” condition, verify contact closure between pins 1 and 6 and no contact closure between pins 1 and 9 of the RS-232/Nurse Call connector. Under the alarm condition, verify contact closure between pins 1 and 9 and no contact closure between pins 1 and 6.

‡ Option available only on units with software revision 5.00.

* On units with boards with no test switch, the first pass through may indicate “rs 232 FAIL” due to the varying warm-up times of the ThermaLink board and the control board. Do not shut the unit off; continue to run the test. If the ThermaLink board is functioning correctly, the display should show “rs 232 PASS” in all subsequent cycles.

3/Infant Warmer Modifications

This section describes how to reconfigure standard warmers to meet special clinical needs.

3.1 Converting Units for Operating Room Use

Reversing the display module's display panel allows an anesthesiologist to monitor patient temperature. If this operating room conversion is desired, follow the next steps.

A. Disassembly for Reversal

1. Remove all 4 mounting screws from the bottom of the display module and set them aside.

2. Disassemble the display module, performing steps 1 through 7 in section 5.2C - "Display Module Disassembly".

3. Remove both the control board and power supply boards, performing all the steps in section 5.2B - "Control Board Removal" and "Power Supply Board Removal".

For units with Software Revision 4.01 or higher, perform steps 4 through 6.

4. Thread the shielded display ribbon cable out of the slot in the top of the display module. Set aside the 2 spring clips that secure it to the shield. See Figure 5-10.

5. Remove the nuts and washer that secure the display board to the ESD shield. Remove the ground wire, if present.

6. Separate the display board from the ESD shield, but leave the ribbon cable connected to the display board.

B. Ribbon Cable Preparation (Only for units with Software Revision 4.01 of higher)

1. Peel back the foil ESD shielding wrapped around the ribbon cable, taking care not to tear it.

2. Untwist the bend in the ribbon cable, so that the cable lies flat.

3. Re-wrap the foil ESD shielding around the cable, taking care to keep the shielding as close to the control board end connector as possible

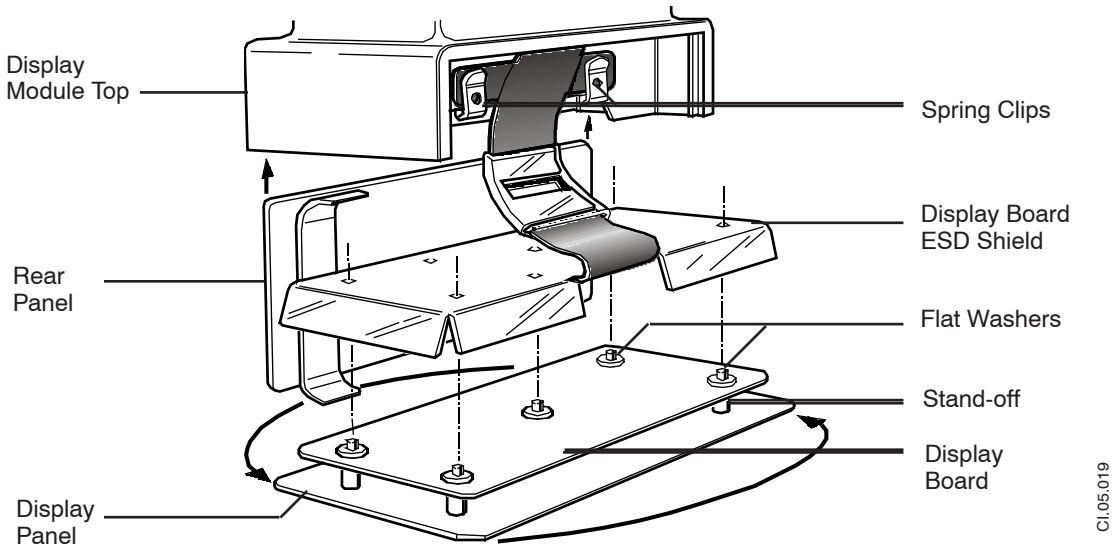


Figure 3-1
Turning the Display Board

C. Reversing the Display

For units prior to Software Revision 4.01, omit steps 1 through 6.

1. Place 2 flat washers on each of the display board stand-offs.

2. Attach the assembled display board and display panel to the ESD shield, turning them 180° as shown in Figure 3-1, so that the display panel assembly stand-offs fit the second set of holes in the shield. Figure 5-10 shows the ground wire attached to the top left stand-off. Reattach the ground wire (if present) to the bottom right stand-off as shown in Figure 3-2.

3. Thread the flattened ribbon cable through the rectangular slot formed by the folded-in flaps of the control board ESD shield and through the matching slot in the shield.

4. Thread the display board ribbon cable through the slot in the top of the display module and the slot in the control board shield. Pull any slack in the ribbon cable back up into the control unit, so that the end of the cable's foil wrapped shielding shows in the middle of the slot in the folded-in flaps. See Figure 3-2.

5. Flip over the reassembled display board, display panel assembly and display ESD shield , and slide it into the slot in the back of the display module top, so the display panel faces back, away from the warmer bed. The ribbon cable will now pass in front of the unshielded side of the display board, not behind it as it would in standard display module orientation.

6. Figure 5-5 shows the ribbon cable secured to the ESD shield with both spring clips on the right side of the cable. Re-secure the ribbon cable with a spring clip on either side of where the cable passes through the rectangular slot in the display board ESD shield. See Figure 3-2.

7. Slide the rear panel into the slot in the front of the display module top, so that it faces toward the warmer bed.

8. Reattach the display board ground wire (if present) to the fastons on the rear display panel. Verify that the 2 spring clips that secure the display board ESD shield to the display module top cover, and the 2 spring clips that hold the display ribbon cable to the ESD shield, are still firmly in place.

9. Reinstall the bottom cover of the display module. Be careful not to over tighten the 4 cover mounting screws.

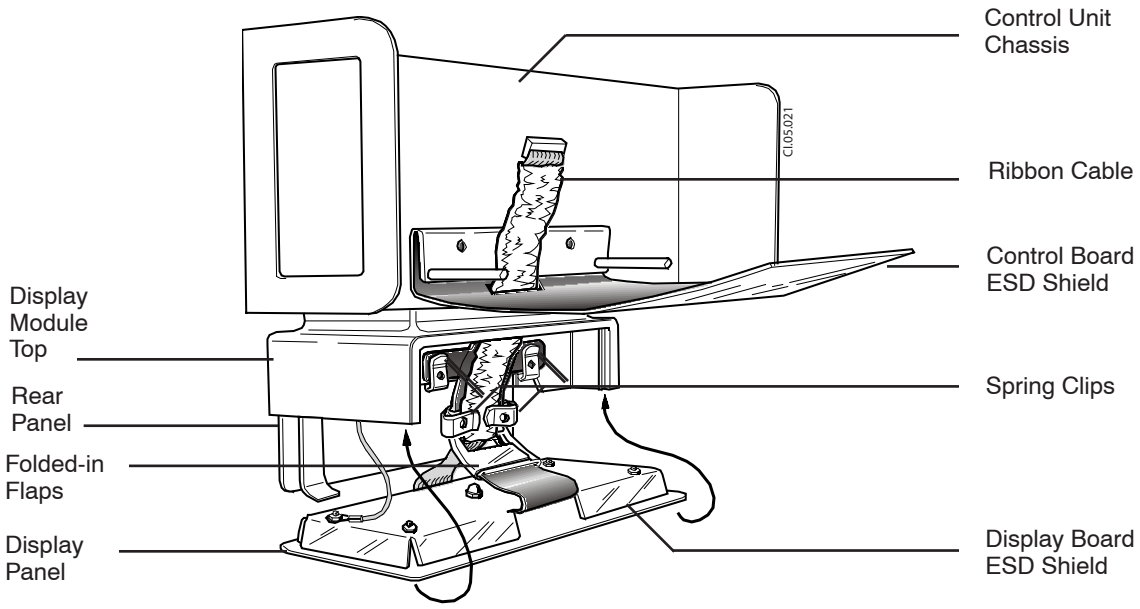


Figure 3-2
Flipping the display

D. Control Unit Reassembly

1. Install the power supply board, performing all the steps in 5.2B- “Power Supply Board Installation”.

2. Install the control board, performing all the steps in 5.2B - “Control Board Installation”.

3. Complete Section 2.2.2 control unit checkout procedure prior to putting the unit back in service

3.2 Changing Patient Temperature Alarm Limits

(See Figure 3-3)

The patient temperature alarm occurs if the difference between the patient temperature and the control temperature is greater than 1°C. This procedure allows that difference to be adjusted to 0.5°C.

Note: This procedure does not apply to IWS 2001 International units, which are manual mode only warmers and do not have patient temperature alarms.

1. Disconnect the power cord from the AC power source.
2. Remove the control cover. Fold down the ESD shield (if present) to access the control board.
3. If the dipswitch on the control board has 8 switches, set switch 4 to ON. If the dipswitch has 4 four switches, set 1 and 2 ON, and 3 and 4 OFF.
4. Bend the ESD shield (if present) back up into place.
5. Replace the 2 cover screws for the control unit cover.
6. Complete Section 2.2.2 control unit checkout procedure prior to putting the unit back in service.

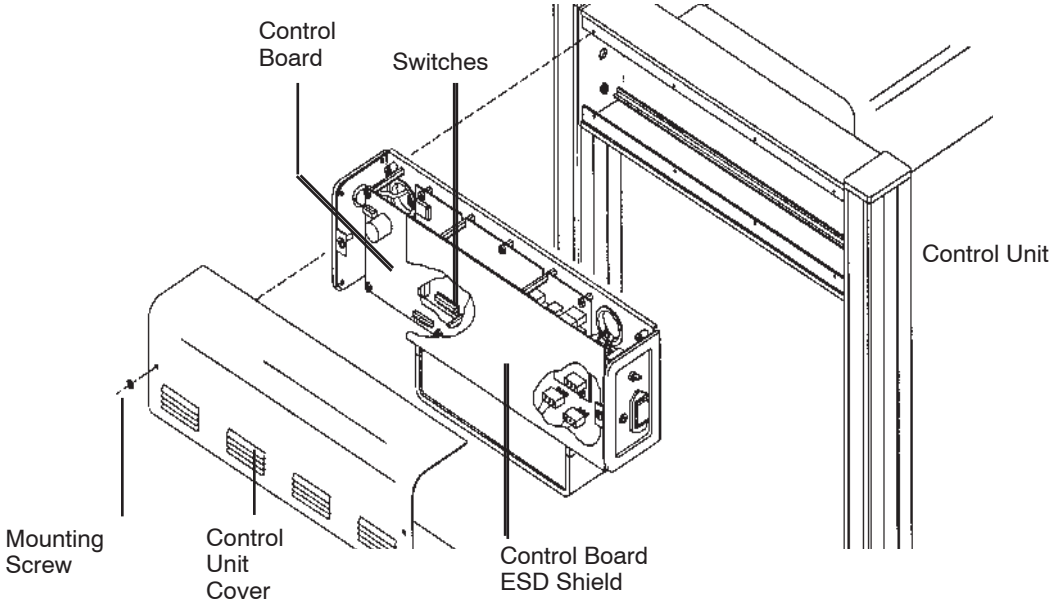


Figure 3-3
Accessing Control Board Switches

3.3 Lowering Heater and Bed Height

(Non-elevating Models Only)

A. Control Module Removal

(See Figure 5-6)

1. Disconnect the warmer power cord from the AC power source.

2. Remove the two center mounting screws from the bottom of the display module.

3. Remove the two mounting screws for the control unit cover and remove the cover. Fold the ESD shield, if present, down away from the control board.

4. Disconnect the two connectors, J17 and the three pin chassis connector for the observation light to the right of the power board. Squeeze the locking tabs on the rear of the plug to disengage the lock mechanism.

5. Loosen the four corner mounting screws for the control unit and carefully remove the control module. Place the control unit on a flat surface so it rests on the transformers.

B. Heater and Bed Height Adjustment

1. To adjust bed height, remove the eight mounting screws on the back of the lower cross bar extrusion, remove the rear cover plate, and set them aside.

2. Loosen the ground screw(s) on the inside left and right hand sides of the lower and upper cross bar extrusions.

3. On the lower cross bar extrusion, loosen the upper and lower nuts of the left and right locking lug assemblies. Carefully adjust the bed height by moving the lower cross bar down until the desired floor to bed mattress height is achieved.

4. On the lower cross bar extrusion, retighten the upper and lower nuts of the left and right locking lug assemblies and torque to 125 ± 5 lb-in.

   Note: On model 4300 warmers with a rotating drawer package installed, the support post under the bed casting (behind the drawers) must also be removed and cut down to a shorter length. After the modification a new support post must be ordered to raise the bed height once again.

5. To adjust heater height, loosen the upper and lower nuts of the left and right locking lug assemblies on the upper cross bar extrusion. Carefully adjust the heater height by moving the upper cross bar down until the distance from the heater grill to center of the bed mattress is 27 ± 2 in. (69 ± 5cm).

WARNING

⚠ Bed to heater spacing less than the recommended 25 inches will result in incorrect operation and may adversely affect patient condition.

Warmers shipped since 1993 have higher wattage heaters that allow bed to heater spacing of 27-2, + 9 inches, making them compatible with many kinds of bassinets.

Since very low birth weight babies may require tighter control of the heat provided to them, we recommend that on warmer models that incorporate a built-in bed and are intended for care of low birth weight babies, the distance between heater and bed be maintained at 27±2 inches.

6. On the upper cross bar extrusion, retighten the upper and lower nuts of the left and right locking lug assemblies and torque to 125 ± 5 lb-in.

7. Retighten the ground screws on the inside left and right hand sides of the lower and upper cross bar extrusions and torque to 25 ± 5 lb-in.

8. Replace the rear cover plate on the back of the lower cross bar extrusion and tighten in place using the eight mounting screws set aside in step 1 above.

C. Control Module Replacement

(See Figure 5-6)

1. Carefully place the control module in position and tighten the four mounting screws for the control unit.

2. Reconnect the two connectors, J17 and the three pin chassis connector to the right of the power board to the power supply board.

3. Hold the display module in position and replace the two inside mounting screws on the bottom.

4. Bend the ESD shield (if present) back up into place.

5. Place the control unit cover in position and replace the two mounting screws.

6. Perform the electrical safety and the calibration procedures in Section 4. Perform the checkout procedures detailed in Section 2.2.

4.1 Maintenance Schedule

The unit should be maintained in accordance with the procedures detailed in this manual. Service maintenance must be performed by a technically competent individual as described on page ii.

This schedule lists the minimum frequencies. Always follow hospital and local regulations for required frequencies.

Per hospital protocol	Perform the electrical safety and checkout procedure from this manual.
Biannually	Check the calibration and perform the service checkout procedures as detailed in this manual.
Annually	Inspect the yoke strainer nipples and replace if necessary (On models equipped with gas package).
Every two years	Replace the battery.
Every five years	Replace the regulator(s) (On models equipped with gas package).

IWS models shipped with Serial Number HCA or HCC have a electronic controller common to all models. This change was made to simplify servicing future IWS models, to incorporate changes necessary to comply with international standards, and to minimize susceptibility to EMI.

IWS units with software revision 06.00 and higher have a controller board identified by a eight position dip switch, surface mounted components (SMT), and a 12 pin pin test connector. Refer to section 4.2 for calibration and adjustment of this controller board.

All IWS units with software revision 4.01 through 05.10 have controller board identified by the presence of an eight position dip switch, through hole components, and a 7 pin test connector. Refer to Section 4.3 for calibration and adjustment of this controller board.

To facilitate service of IWS product with a controller board software revision prior to 4.01, a separate section on Calibration and Adjustment has been included. This older controller board is identified by the four position dip switch. Refer to Section 4.4 for calibration and adjustment of Infant Warmers with this controller board.

WARNING ⚠ Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

CAUTION Use the Static Control Work Station (Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Note: The audio alarm will sound for about 2 seconds whenever powering up the unit.

Note: Warm up the unit for 5 minutes before making these adjustments.

4.2 Controller Calibration (Software Revision 06.00 or higher)

This section is to be used for calibration and adjustment of Infant Warmer Systems with Software Revision “6.00” or higher. Refer to Section 8 for detailed circuit diagrams.

The controller board contains an eight position dip switch. The state or configuration of each switch position may change, i.e. On or Off, during the calibration procedure, depending on the adjustment procedure. The function of each switch position and the normal state is given below:

Switch Position Function	1	2	3	4	5	6	7	8
PTG Alarm 1.0 °C	X	X	X	0	X	X	0	0
PTG Alarm 0.5 °C	X	X	X	1	X	X	0	0
RS-232 Normal Mode	X	X	X	X	X	0	0	0
RS-232 Reserved	X	X	X	X	X	1	X	X
Normal Operation	X	X	X	X	X	X	0	0
Service Loop/ RS 232 Diagnostics Mode	X	X	X	X	X	X	0	1
A/D Calibration Loop/ RS-232 Diagnostics Mode	X	X	X	X	X	X	1	0
Line Volt Cal Loop/ RS-232 Diagnostic Mode	X	X	X	X	X	X	1	1

X= no effect (but should remain in “Off” position) 0= Off 1= On

4.2.1 Control Unit Access

1. Disconnect the power cord for the Infant Warmer System from the wall outlet.
2. Remove the mounting screws for the controller cover. Remove the controller cover.
3. Fold the ESD shield down (if present), away from the controller board.
4. Note the positions of the test switch SW1 located on the control board before performing the operations in this section. Be sure to replace the test switch to these original positions before returning the unit to service.

4.2.2 Power Supply Board Voltages

1. All eight positions on test switch (SW1) should be Off.

2. Connect the controller assembly to an appropriately rated power source (listed voltage ± 10%), and switch the power switch On.

   Note: You will go through the normal start up routine. Patient temperature alarms may trigger.

3. Check that the following dc voltages are present at the test connector (TP1) located on the control board. Voltages should be within the tolerances specified; otherwise follow the recommended corrective action:

Test Point	Reading	Corrective action
TP9 Ground (common)	—	—
TP5 (9.0 Vdc ST.)	9 ± 0.2 Vdc	adjust R4 on Power Supply PCB
TP4 (5.0 Vdc LEDS)	5 ± 0.3 Vdc	replace Power Supply PCB
TP1 (5.0 Vdc ST.)	5 ± 0.3 Vdc	replace Power Supply PCB

4. If no corrective actions are required, continue with Section 4.2.3, Display Brightness, at step 2.

4.2.3 Display Brightness Check

Note: The display brightness is pre-calibrated at the factory and should only require adjustment if replacing a component on the display board.

Test Procedure

1. All eight positions on controller board dip switch (SW1) should be Off. Connect the controller assembly to an appropriately rated power source and switch the power switch On.

2. Hold the Alarm Silence switch down for five seconds.

3. Check that all the displays are illuminated and are of uniform brightness.

   Note: IWS 2001 International units do not have a control temperature display, servo mode indicator, or probe failure indicator.

4. If the displays are acceptable proceed to Section 4.2.4, Alarm Volume, at step 2. If the displays are not illuminated adequately proceed with the adjustment procedure.

Adjustment Procedure

CAUTION ⚠ The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

1. Switch the power switch Off and unplug the unit.
2. Tape the display panel and back panel to the top cover.
3. Remove the four outside corner mounting screws from the bottom of the display panel. Do not remove the two inside mounting screws. Remove the bottom display cover by sliding it down.
4. Fold out the bottom edge of the ESD shield to access the display board. Connect a digital voltmeter across R13 or connector J23, located near the right edge of the display board.
5. Connect the controller assembly back to the appropriately rated power source.
6. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine. “CAL” appears in the patient temperature display and “AdC” appears in the control temperature display.
7. Adjust R1 on the display board until the voltage across R13 (J23) is 3.30 ± 0.2 Vdc.
8. Switch the power switch Off and then back On and verify that all segments of all displays are illuminated and are of uniform brightness.
9. Switch the power switch Off.
10. Fold the edge of the ESD shield back into place. Replace the bottom of the display panel using the four screws previously removed.
11. Continue with Section 4.2.4, Alarm Volume, at step 2.

4.2.4 Alarm Volume

WARNING ⚠ Lowering the volume excessively may prevent caregivers from hearing alarms. The alarm volume and frequency are precalibrated at the factory for both replacement boards and controllers. Volume adjustments should not normally be required in the field.

Test Procedure

1. All eight positions on controller board dip switch (SW1) should be Off. Switch the Infant Warmer On.
2. Activate the alarm by selecting the servo mode and unplugging the patient probe, or alternatively, hold down the Alarm Silence switch for five seconds (IWS 2001 International models). You should hear an intermittent tone for the first 30 seconds, followed by an alternating two tone alarm.
3. Ensure the alarm tone and volume are at the desired levels. Verify that the audio alarm level is adequate in a location with a background noise level of 55 dBA max. If the audio alarm level is acceptable, continue with Section 4.2.5, Analog to Digital Converter Calibration, at step 3. If the audio alarm level is unacceptable, continue with the adjustment procedure.

Adjustment Procedure

1. Switch the power switch Off.
2. All eight positions on controller board dip switch (SW1) should be Off.

   Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine.
3. Verify that the frequency at pin 8 of the control board test connector TP1 is 2.050 kHz ± 0.1 kHz. Adjust RP4 on the control board as required to achieve the desired frequency.
4. Adjust volume to maximum with RP1. The factory seting is 92 ± 4 dBa , and lower settings are not recommended.
5. Continue with Section 4.2.5, Analog to Digital Converter Calibration.

4.2.5 Analog to Digital Converter (ADC) Calibration

4.2.5.1 Verification

1. Switch the power switch Off.
2. All eight positions on controller board dip switch (SW1) should be Off.

   Connect the controller assembly to an appropriately rated power source and switch the power switch On and allow the unit to stabilize for 5 minutes.
3. Connect the following resistances to the patient jack and verify the patient temperature readings:

Resistance	Switch Setting	Patient Temperature Display
5496 Ω ± 0.1%	I2	39.0 ± 0.1 degrees
7060 Ω ± 0.1%	I3	33.0 ± 0.1 degrees
5900 Ω ± 0.1%	I7	37.3 ± 0.1 degrees
6190 Ω ± 0.1%	I11	36.2 ± 0.1 degrees

4. Depress the Start/Hold switch for five seconds.
5. Verify that the correct values appear for the cal low and cal high resistors:

   Patient temp: 25.0 ± 0.3°C (cal low signal; 1 decimal place)

   Control temp: 37.9 ± 0.3°C (cal high signal; 1 decimal place)

   Note: Only the cal low reading appears on IWS 2001 International units, which do not have a control temperature display.
6. If the displayed values are within tolerances, continue with Section 4.2.6, Line Voltage Compensation. Otherwise, record if the temperatures differ from their target values by more than a half degree centigrade and continue with the adjustment procedure, with one of the following methods. The quicker method in 4.2.5.3 requires a 0.1% accurate resistance decade box. The older method in 4.2.5.2 requires the Ohmeda Temperature Simulator Box.

4.2.5.2 Adjustment Procedure (with Ohmeda Temp. Simulator Box)

Note: If the unit is cold, let it operate for five minutes before starting this adjustment.

1. Switch the power switch Off.

2. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine.

3. Connect a resistance of 5900 Ω ± 0.1% to the patient probe connector with switch setting I7 on the Ohmeda Temperature Simulator Box. Adjust RP3 to obtain a reading of 37.37 ± 0.02°C in the elapsed time display.

   Note: The decimal point does not appear. Although the tolerance is ± 0.02°C, the readings should be adjusted as closely as possible to the nominal value; the ± 0.02°C allows for variation in measured temperature due to system noise, etc.

4. Connect a resistance of 7686 Ω ± 0.1% to the patient probe connector with switch setting I1 on the Ohmeda Temperature Simulator Box. Adjust RP2 to obtain a reading of 31.09 ± 0.02°C in the elapsed time display.

5. Repeat steps 3 and 4 until no further adjustment is required.

6. Switch the power switch Off, wait 5 seconds and switch the power switch back On.

7. Connect the following resistances to the patient probe connector and verify the correct temperature readings appear in the patient temperature display.

Resistance	Switch Setting	Patient Temperature Display
5496 Ω ± 0.1%	(I2)	39.0 ± 0.1 degrees
7060 Ω ± 0.1%	(I3)	33.0 ± 0.1 degrees
5900 Ω ± 0.1%	(I7)	37.3 ± 0.1 degrees
6190 Ω ± 0.1%	(I11)	36.2 ± 0.1 degrees

   Note: The resistance values shown above are available on the Ohmeda Temperature Simulator Box. The switch positions are listed in parentheses.

8. Continue with Section 4.2.6, Line Voltage Compensation.

4.2.5.3 Adjustment Procedure (with a 0.1% accurate resistance decade box)

1. Check the readings from the calibration resistors. Depress and hold the Start/Hold switch for 5 seconds until the proper calibration readings appear in the patient and air temperature displays:

   Patient Temperatue 25.05 ± 0.2 °C

   Air Temperature 37.97 ± 0.2°C

   If these values are in tolerance, no calibration is necessary (skip to section 4.2.6)

2. Adjust the resistance decade box to 2.980K ohms and plug into the patient sensor jack.

3. Turn power off and press Start/Hold while turning power on.

4. Adjust pot RP3 until the control temperature display toggles between 000 and 001.

5. Set the resistance decade box to a 32.789K ohm resistance and plug into the patient sensor jack.

6. Adjust pot RP2 until the control temperature display toggles between F9E and F9F.

7. Check accuracy with the following values:

Resistance Input (ohms)	Patient Temperature Display
5509	39.0± 0.1°C
5981	37.0
6500	35.0

8. Disconnect the resistance box from the patient probe jack.

9. Switch the unit off. Calibration is complete.

4.2.6 Line Voltage Compensation

WARNING ⚠ Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

Test Procedure

1. Switch the power switch Off.

2. All eight positions on dip switch (SW1) should be Off.

3. Use a Digital Volt Meter and measure the line voltage at the wall outlet.

4. Connect the controller assembly to an appropriately rated power source and switch the power switch On.

5. Read the corresponding percent of your unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage selects the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage is 95% and 950 ± 20 should appear in the elapsed time display in step 7.

   Note: Record this value from the table for later use.

Line (Outlet Voltage)				% Nominal (Nom.) Line Voltage x10 (Elapsed time display)
95V Nom.	115V Nom.	220V Nom.	230/240V Nom.	
86	104	199	217	900±20
87	105	201	219	910±20
88	106	203	221	920±20
89	107	205	224	930±20
90	109	207	226	940±20
91	110	210	229	950±20
92	111	212	231	960±20
93	112	214	233	970±20
94	113	216	236	980±20
95	115	220	240	1000±20
96	117	223	243	1010±20
97	118	225	245	1020±20
98	119	227	248	1030±20
99	120	229	250	1040±20
100	121	232	253	1050±20
101	122	234	255	1060±20
102	124	236	257	1070±20
103	125	238	260	1080±20
104	126	240	262	1090±20
105	127	243	265	1100±20

6. Depress the Start/Hold switch for five seconds.

7. Verify that the value in the elapsed time display equals the percent of nominal voltage read from the table in step 5.

8. If the displayed values are within tolerances, continue with Section 4.4, Oxygen/Air Regulator Checks and Adjustments. Otherwise, continue with the adjustment procedure below.

Adjustment Procedure

1. Switch the power switch Off.

2. Depress and hold down the Reset switch while you switch the power switch On to enter the % Line Voltage Calibration routine.

3. Slowly adjust R3 on power supply board as required until the elapsed time display equals the value read from the table in step 5 of the test procedure.

4. Continue with Section 4.5, Oxygen/Air Regulator Checks and Adjustments.

4.3 Controller Calibration
(Software Revision 04.01 through 05.10)

This section is to be used for calibration and adjustment of Infant Warmer Systems with Software Revision “4.01” through “5.10”. Refer to Section 8 for detailed circuit diagrams.

The controller board contains an eight position dip switch. The state or configuration of each switch position may change, i.e. On or Off, during the calibration procedure, depending on the adjustment procedure. The function of each switch position and the normal state is given below:

Switch Position	1	2	3	4	5	6	7	8
Function								
PTG Alarm 1.0 °C	X	X	X	0	X	X	0	0
PTG Alarm 0.5 °C	X	X	X	1	X	X	0	0
RS-232 Normal Mode	X	X	X	X	X	0	0	0
RS-232 Reserved	X	X	X	X	X	1	X	X
Normal Operation	X	X	X	X	X	X	0	0
Service Loop/	X	X	X	X	X	X	0	1
RS 232 Diagnostics Mode								
A/D Calibration Loop/	X	X	X	X	X	X	1	0
RS-232 Diagnostics Mode								
Line Volt Cal Loop/	X	X	X	X	X	X	1	1
RS-232 Diagnostic Mode								
X= no effect (but should remain in “Off” position)				0= Off		1= On		

4.3.1 Control Unit Access

1. Disconnect the power cord for the Infant Warmer System from the wall outlet.
2. Remove the mounting screws for the controller cover. Remove the controller cover.
3. Fold the ESD shield down (if present), away from the controller board.
4. Note the positions of the test switch S1 located on the control board before performing the operations in this section. Be sure to replace the test switch to these original positions before returning the unit to service.

4.3.2 Power Supply Board Voltages

1. All eight positions on test switch (S1) should be Off.
2. Connect the controller assembly to an appropriately rated power source (listed voltage ± 10%), and switch the power switch On.

   Note: You will go through the normal start up routine. Patient temperature alarms may trigger.
3. Check that the following dc voltages are present at the test connector (T1) located on the control board. Voltages should be within the tolerances specified; otherwise follow the recommended corrective action:

Test Point	Reading	Corrective action
TP7 Ground (common)	—	—
TP3 (9.0 Vdc ST.)	9 ± 0.2 Vdc	adjust R4 on Power Supply PCB
TP4 (5.0 Vdc LEDS)	5 ± 0.3 Vdc	replace Power Supply PCB
TP5 (5.0 Vdc ST.)	5 ± 0.3 Vdc	replace Power Supply PCB

4. If no corrective actions are required, continue with Section 4.3.3, Display Brightness, at step 2.

4.3.3 Display Brightness Check

Note: The display brightness is pre-calibrated at the factory and should only require adjustment if replacing a component on the display board.

Test Procedure

1. All eight positions on controller board test switch (S1) should be Off. Connect the controller assembly to an appropriately rated power source and switch the power switch On.
2. Hold the Alarm Silence switch down for five seconds.
3. Check that all the displays are illuminated and are of uniform brightness.

   Note: IWS 2001 International units do not have a control temperature display, servo mode indicator, or probe failure indicator.
4. If the displays are acceptable proceed to Section 4.3.4, Alarm Volume, at step 2. If the displays are not illuminated adequately proceed with the adjustment procedure.

Adjustment Procedure

CAUTION

⚠ The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

1. Switch the power switch Off and unplug the unit.

2. Tape the display panel and back panel to the top cover.

3. Remove the four outside corner mounting screws from the bottom of the display panel. Do not remove the two inside mounting screws. Remove the bottom display cover by sliding it down.

4. Fold out the bottom edge of the ESD shield to access the display board. Connect a digital voltmeter across R10, located on the bottom edge of the display board.

5. Connect the controller assembly back to the appropriately rated power source.

6. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine. “CAL” appears in the patient temperature display and “AdC” appears in the control temperature display.

7. Adjust R9 on the display board until the voltage across R10 is 3.30 ± 0.2 Vdc.

8. Switch the power switch Off and then back On and verify that all segments of all displays are illuminated and are of uniform brightness.

9. Switch the power switch Off.

10. Fold the edge of the ESD shield back into place. Replace the bottom of the display panel using the four screws previously removed.

11. Continue with Section 4.3.4, Alarm Volume, at step 2.

4.3.4 Alarm Volume

WARNING ⚠ Lowering the volume excessively may prevent caregivers from hearing alarms. The alarm volume and frequency are precalibrated at the factory for both replacement boards and controllers. Volume adjustments should not normally be required in the field.

Test Procedure

1. All eight positions on controller board test switch (S1) should be Off. Switch the Infant Warmer On.

2. Activate the alarm by selecting the servo mode and unplugging the patient probe, or alternatively, hold down the Alarm Silence switch for five seconds (IWS 2001 International models). You should hear an intermittent tone for the first 30 seconds, followed by an alternating two tone alarm.

3. Ensure the alarm tone and volume are at the desired levels. Verify that the audio alarm level is adequate in a location with a background noise level of 55 dBA max. If the audio alarm level is acceptable, continue with Section 4.3.5, Analog to Digital Converter Calibration, at step 3. If the audio alarm level is unacceptable, continue with the adjustment procedure.

Adjustment Procedure

1. Switch the power switch Off.

2. All eight positions on controller board test switch (S1) should be Off.

   Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine.

3. Verify that the frequency at pin 1 of the control board test connector is 2.050 kHz ± 0.1 kHz. Adjust R38 on the control board as required to achieve the desired frequency.

4. Continue with Section 4.3.5, Analog to Digital Converter Calibration.

4.3.5 Analog to Digital Converter (ADC) Calibration

1. Switch the power switch Off.

2. All eight positions on controller board test switch (S1) should be Off.

   Connect the controller assembly to an appropriately rated power source and switch the power switch On and allow the unit to stabilize for 5 minutes.

3. Connect the following resistances to the patient jack and verify the patient temperature readings:

Resistance	Switch Setting	Patient Temperature Display
5496 Ω ± 0.1%	I2	39.0 ± 0.1 degrees
7060 Ω ± 0.1%	I3	33.0 ± 0.1 degrees
5900 Ω ± 0.1%	I7	37.3 ± 0.1 degrees
6190 Ω ± 0.1%	I11	36.2 ± 0.1 degrees

4. Depress the Start/Hold switch for five seconds.

5. Verify that the correct values appear for the cal low and cal high resistors:

   Patient temp: 25.0 ± 0.3°C (cal low signal; 1 decimal place)

   Control temp: 37.9 ± 0.3°C (cal high signal; 1 decimal place)

   Note: Only the cal low reading appears on IWS 2001 International units, which do not have a control temperature display.

6. If the displayed values are within tolerances, continue with Section 4.3.6, Line Voltage Compensation. Otherwise, record if the temperatures differ from their target values by more than a half degree centigrade and continue with the adjustment procedure.

Adjustment Procedure

Note: If the unit is cold, let it operate for five minutes before starting this adjustment.

1. Switch the power switch Off.
2. Depress and hold down the Start/Hold switch while you switch the power switch On to enter the ADC calibration routine.
3. Connect a resistance of 5900 Ω ± 0.1% to the patient probe connector.

   Note: 5900 Ω ± 0.1% is switch setting I7 on the temperature simulator box.
4. If the temperature displays in the calibration check differed from the target values by less than half a degree centigrade, continue with step 5. Otherwise:
   a. Connect a voltmeter between pins 10 and 7 of the control board test connector.
   b. Set the voltage at TP10 to 2.000 Vdc by adjusting R44.
   c. Connect the voltmeter between pins 9 and 7 of the control board test connector.
   d. Set the voltage at TP9 to 0.368 Vdc by adjusting R52. Then, disconnect the voltmeter.
5. Connect a resistance of 5900 Ω ± 0.1% to the patient probe connector. Adjust R52 to obtain a reading of 37.37 ± 0.02°C in the elapsed time display.

   Note: The decimal point does not appear. Although the tolerance is ± 0.02°C, the readings should be adjusted as closely as possible to the nominal value; the ± 0.02°C allows for variation in measured temperature due to system noise, etc.
6. Connect a resistance of 7686 Ω ± 0.1% to the patient probe connector. Adjust R44 to obtain a reading of 31.09 ± 0.02°C in the elapsed time display.

   Note: 7686 Ω ± 0.1% is switch setting I1 on the temperature simulator box.
7. Repeat steps 5 and 6 until no further adjustment is required.
8. Switch the power switch Off, wait 5 seconds and switch the power switch back On.
9. Connect the following resistances to the patient probe connector and verify the correct temperature readings appear in the patient temperature display.

Resistance	Switch Setting	Patient Temperature Display
5496 Ω ± 0.1%	(I2)	39.0 ± 0.1 degrees
7060 Ω ± 0.1%	(I3)	33.0 ± 0.1 degrees
5900 Ω ± 0.1%	(I7)	37.3 ± 0.1 degrees
6190 Ω ± 0.1%	(I11)	36.2 ± 0.1 degrees

   Note: The resistance values shown above are available on the Temperature Simulator. The switch positions are listed in parentheses.
10. Continue with Section 4.3.6, Line Voltage Compensation.

4.3.6. Line Voltage Compensation

WARNING

⚠ Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

Test Procedure

1. Switch the power switch Off.
2. All eight positions on test switch (S1) should be Off.
3. Use a Digital Volt Meter and measure the line voltage at the wall outlet.
4. Connect the controller assembly to an appropriately rated power source and switch the power switch On.
5. Read the corresponding percent of your unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage selects the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage is 95% and 950 ± 20 should appear in the elapsed time display in step 7.

   Note: Record this value from the table for later use.

Line (Outlet Voltage)				% Nominal (Nom.) Line Voltage x10 (Elapsed
95V Nom.	115V Nom.	220V Nom.	230/240V Nom.	time display)
86	104	199	217	900±20
87	105	201	219	910±20
88	106	203	221	920±20
89	107	205	224	930±20
90	109	207	226	940±20
91	110	210	229	950±20
92	111	212	231	960±20
93	112	214	233	970±20
94	113	216	236	980±20
95	115	220	240	1000±20
96	117	223	243	1010±20
97	118	225	245	1020±20
98	119	227	248	1030±20
99	120	229	250	1040±20
100	121	232	253	1050±20
101	122	234	255	1060±20
102	124	236	257	1070±20
103	125	238	260	1080±20
104	126	240	262	1090±20
105	127	243	265	1100±20

6. Depress the Start/Hold switch for five seconds.

7. Verify that the value in the elapsed time display equals the percent of nominal voltage read from the table in step 5.

8. If the displayed values are within tolerances, continue with Section 4.5, Oxygen/ Air Regulator Checks and Adjustments. Otherwise, continue with the adjustment procedure below.

Adjustment Procedure

1. Switch the power switch Off.

2. Depress and hold down the Reset switch while you switch the power switch On to enter the % Line Voltage Calibration routine.

3. Slowly adjust R3 on power supply board as required until the elapsed time display equals the value read from the table in step 5 of the test procedure.

4. Continue with Section 4.5, Oxygen/Air Regulator Checks and Adjustments.

4.4 Controller Calibration (Prior to Software Revision 04.01)

This section has been included to facilitate service of IWS product with controller board with a Software Revision prior to 4.01. Refer to Section 8 for a detailed circuit diagram.

This controller board is identified by the presence of a four position dip switch; controller boards with software revision 4.01 or higher have an eight position dip switch. This board is no longer available. If this board fails the calibration and adjustment section, the board should be replaced. When replacing this board order controller service kit:

6600-0360-800	EMI Noise Suppression Kit for English IWS Models
6660-0360-801	EMI Noise Suppression Kit for French IWS Models
6600-0360-802	EMI Noise Suppression Kit for Spanish IWS Models
6600-0360-803	EMI Noise Suppression Kit for German IWS Models
6600-0360-804	EMI Noise Suppression Kit for Spanish IWS 2001 Models
6600-0360-805	EMI Noise Suppression Kit for French IWS 2001 Models
6600-0360-806	EMI Noise Suppression Kit for English IWS 2001 Models

Each controller service kit includes EMI shielding to minimize susceptibility of the replacement controller board to electrostatic discharge, power line conducted noise and radiated electromagnetic interference. See Section 7 for a list of the kits contents.

The earlier version controller board contains a four position dip switch. The setting of each switch position may change (On or Off) during the calibration procedure, depending on the adjustment procedure being performed.

	Dipswitch Position			
	1	2	3	4
PTG Alarm 1.0 degree	0	0	0	0
PTG Alarm 0.5 degree	1	1	0	0
Cal Display Loop	0	0	1	0
Cal ADC Loop	0	0	0	1
Triac Test Loop	0	1	1	1
Service Loop	1	1	1	1

0 = Off 1 =On

4.4.1 Power Supply Board Voltages

1. Configure the four position test switch (S1) located on the control board as follows:

   Switch #1,#2, #4 Open (Off)

   Switch #3 Closed (On)

2. Connect the controller assembly to an appropriately rated power source (listed voltage ± 10%), and switch the power switch On.

   Note: You will go through the normal start up routine. Patient temperature alarms may trigger.

3. Check that all display segments are On, the observation lamp is On, the alarm light is On, the heater radiates heat, and a continuous alarm tone sounds.

4. Check that the following dc voltages are present at the test connector (T1) located on the control board. Voltages should be within the tolerances specified; otherwise follow the recommended corrective action:

Test Point	Reading	Corrective action
TP7 Ground (common)	—	—
TP3 (9.0 Vdc ST.)	9 ± 0.2 Vdc	adjust R4 on Power Supply PCB
TP4 (5.0 Vdc LEDS)	5 ± 0.3 Vdc	replace Power Supply PCB
TP5 (5.0 Vdc ST.)	5 ± 0.3 Vdc	replace Power Supply PCB

4.4.2 Display Brightness Check

Note: The display brightness is pre-calibrated at the factory and should only require adjustment if replacing a component on the display board.

Test Procedure

1. Configure the four position test switch (S1) on the control board as follows:

   Switch #1, #2, #4 Open (Off)

   Switch #3 Closed (On)

   Connect the controller assembly to an appropriately rated power source and switch the power switch On.

2. Check that all the displays are illuminated and are of uniform brightness.

   Note: IWS 2001 International units do not have a control temperature display.

3. If the displays are acceptable proceed to Section 4.4.3, Alarm Volume, at step 2. If the displays are not adequately illuminated, proceed with the adjustment procedure.

Adjustment Procedure

CAUTION

⚠ The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

1. Switch the power switch Off and unplug the unit.
2. Tape the display panel and back panel to the top cover.
3. Remove the four outside corner mounting screws from the bottom of the display panel. Do not remove the two inside mounting screws. Remove the bottom display cover by sliding it down.
4. Connect a digital voltmeter across R10, located on the bottom edge of the display board.
5. Connect the controller assembly to an appropriately rated power source.
6. Turn On the power switch leaving the test switch S1 settings unchanged from step 1 of the Test Procedure Section above.
7. Adjust R9 on the display board until the voltage across R10 is 3.30 ± 0.2 Vdc.
8. Verify that all segments of all displays are illuminated and are of uniform brightness.
9. Switch the power Off.
10. Replace the bottom of the display panel using the four screws previously removed.

4.4.3 Alarm Volume

WARNING ⚠ Lowering the volume excessively may prevent caregivers from hearing alarms. The alarm volume and frequency are precalibrated at the factory for both replacement boards and controllers. Volume adjustments should not normally be required in the field.

Test Procedure

1. All four positions on test switch (S1) on the controller board should be Off. Switch the power switch On.

2. Activate the alarm by selecting the servo mode and unplugging the patient probe, or alternatively, hold down the Alarm Silence switch for five seconds (IWS 2001 International models). You should hear an alternating two tone alarm.

3. Ensure the alarm tone and volume are at the desired levels. Verify that the audio alarm level is adequate in a location with a background noise level of 55 dBA max. If the audio alarm level is acceptable, continue with Section 4.4.4, Analog to Digital Converter Calibration. If the audio alarm level is unacceptable, continue with the adjustment procedure.

Adjustment Procedure

1. Switch the power switch Off.

2. Positions #1, #2 and #4 on test switch (S1) on the controller board should be Off. Position #3 should be On. Switch the power switch On.

3. Verify that the frequency at pin 1 of the control board test connector is 2.050 kHz ± 0.1 kHz. Adjust R38 on the control board as required.

4. Continue with Section 4.4.4, Analog to Digital Converter Calibration, at step 4.

4.4.4 Analog to Digital Converter (ADC) Calibration

1. Switch the power switch Off.

2. Configure the four position test switch (S1) on the control board as follows:

Switch #1, #2, #3	Open (Off)
Switch #4	Closed (On)

3. Connect the controller assembly to an appropriately rated power source and switch the power switch On and allow the unit to stabilize for 5 minutes.

4. Connect a resistance of 5900 Ω ± 0.1% to the patient probe connector.

   Note: 5900 Ω ± 0.1% is switch setting I7 on the temperature simulator box.

5. Verify that the ADC counts displayed on the elapsed time display is 1122 ± 2 counts. Slowly adjust R44 on control board as required.

6. Connect the following resistances to the patient probe connector and verify the correct temperature readings appear in the patient temperature display.

Resistance	Switch Setting	Patient Temperature Display
5496 Ω ± 0.1%	(I2)	39.0 ± 0.1 degrees
7060 Ω ± 0.1%	(I3)	33.0 ± 0.1 degrees
5900 Ω ± 0.1%	(I7)	37.3 ± 0.1 degrees
6190 Ω ± 0.1%	(I11)	36.2 ± 0.1 degrees

Note: The resistance values shown above are available on the Temperature Simulator. The switch positions are listed in parentheses.

7. If the displayed values are within tolerances, continue with Section 4.4.5, Line Voltage Compensation. If not, replace the control board.

4.4.5 Line Voltage Compensation

WARNING ⚠ Use extreme care while performing calibration and adjustment procedures, or while working on the Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

Test Procedure

1. Set the four dipswitches on the control board to OFF.
2. Switch the power switch On.
3. Press ▼ and turn off heat.
4. Press and hold the hidden switch on the control panel located directly above the alarm silence switch.
5. After two seconds the display should indicate as follows:
   a. Patient Temperature displays 25.0 ± 0.1°
   b. Control Temperature displays 37.9 ± 0.1°
   c. Elapsed Time displays % nominal line voltage ± 2%
6. Switch the power switch Off and unplug the power cord from the wall outlet.
7. Use a digital volt meter and measure the line voltage at the wall outlet.
8. Connect the controller assembly to an appropriately rated power source and turn the power switch On.
9. Read the corresponding percent of your unit's nominal voltage from the following table. The outlet voltage selects the row and the unit's nominal voltage selects the column. For example, if the line voltage measures 110 Vac for a 115 Vac nominal unit, the % nominal voltage is 95% and 95 ± 2 should appear in the control temp display in step 8.

   Note: Record this value from the table for later use.

Line (Outlet Voltage)	% Nominal (Nom.)

95V Nom.	115V Nom.	220V Nom.	240V Nom.	Line Voltage x10 (Elapsed time display)
86	104	199	217	90±2
87	105	201	219	91±2
88	106	203	221	92±2
89	107	205	224	93±2
90	109	207	226	94±2
91	110	210	229	95±2
92	111	212	231	96±2
93	112	214	233	97±2
94	113	216	236	98±2
95	115	220	240	100±2
96	117	223	243	101±2
97	118	225	245	102±2
98	119	227	248	103±2
99	120	229	250	104±2
100	121	232	253	105±2
101	122	234	255	106±2
102	124	236	257	107±2
103	125	238	260	108±2
104	126	240	262	109±2
105	127	243	265	110±2

10. Verify that the value in the elapsed time display equals the percent of nominal voltage read from the table in step 7.

11. If the displayed values are within tolerances, continue with Section 4.4.6, Safety Circuit Test. Otherwise, continue with the adjustment procedure.

Adjustment Procedure

1. Slowly adjust R3 on power supply board as required until the elapsed time display equals the value read from the table.

2. Continue with Section 4.4.6, Safety Circuit Test.

4.4.6 Safety Circuit Test (Prior to Software Revision 03.11)

1. Configure the four position test switch (S1) located on the control board as follows:

Switch #1	Open (Off)
Switch #2, #3, #4	Closed (On)

2. Switch the power switch On.

3. The front panel should display the following:

   Pat. Temp. EEE
   Cont. Temp. EEE

   Elapsed Time Running in Stop Watch Mode

4. Confirm that the heat indicator LED on the control board is illuminated.

5. Use a stop watch and verify that elapsed time display is accurate within ± 1 second per minute.

6. After approximately 3 minutes and 20 seconds (for 60 Hz models) or approximately 4 minutes (50 Hz models) a two tone alarm occurs which cannot be silenced.

7. Confirm the heat indicator LED on the control circuit board (viewed from the rear of unit) is Off.

8. Switch the power switch Off and restore the test switch to the original configuration (all switches Open).

4.4.7 Triac Safety Circuit Test (Rev 03.11 Software Only)

1. Place the individual test switches in the following positions:

   Switch #l Open (“Off”)

   Switch #2,#3, #4 Closed (“On”)

2. Switch the power switch on.

3. The front panel should display the following:

   Pat Temp EEE
   Cont Temp EEE
   Elapsed Time Running in stop watch mode.

4. Let run until the display indicates 03:10 (3 minutes 10 seconds) for 60 hertz units or 03:50 (3 minutes 50 seconds) for 50 hertz units.

   Note: The elapsed timer may reset back to 00:00 and restart timing and the audio alarm activate for 1 second before the time elapses. If so wait until the timer gets back to 03:10 or 03:50.

5. Confirm that the heat indicator LED on the control board is lit.

6. Let the unit run until a warbling two tone alarm which cannot be silenced occurs (5 minutes maximum time).

7. Confirm the elapsed timer stops between 03:10 and 03:40 for 60 hertz units (03:50 and 04:20 for 50 hertz units).

8. Confirm that the heat indicator on the control board is off.

9. Switch the power switch Off and restore the test switch to the original configuration (all switches Open).

4.4.8 Test Loop

Complete Unit Testing

1. Switch the power Off.
2. Configure the four position test switch S1 on the control board in the test loop position. All switches Closed (On).
3. Switch the power switch On.
4. Verify that the following sequence occurs:

   a. For the first second:

      All segments, LEDS, and high-low alternating tone audible alarm are On.

   b. For the next second:

      High-low alternating tone audible alarm On. Patient display “60H” for 60 Hz (“50H” for 50 Hz).

      Elapsed time display - software revision number.

   c. The unit should then loop in the following order until the power is removed:

Seven Seg Display’s	Bar Graph Segments	Alarm LEDs	Mode LEDs	Heater and Lights
All 1’s	1,11	*Probe fail	*Servo	On
All 2’s	2,12	Pat. temp.	*Servo	Off
All 3’s	3,13	Sys. fail	*Servo	On
All 4’s	4,14	Heater Off	Manual	Off
All 5’s	5,15	Reset timer	Manual	On
All 6’s	6,16	Spare LED	Manual	Off
All 7’s	7,17	All Off	Apgar	On
All 8’s	8,18	All Off	Apgar	Off
All 9’s	9,19	All Off	Apgar	On
All 0’s	10,20	All Off	All Off	Off
All Off	All Off	All Off	All Off	Off

* LED indicators not present on IWS 2001 International units.

While looping through this test loop the program also does RAM tests, memory checksum, and ADC calibration tests. If any error occurs, an error number will be displayed in the Elapsed Time display and the critical alarm will sound for 2 seconds. The program will then continue to loop and display any additional error numbers. See Section 6 for error code descriptions.

5. Switch the power switch Off and restore the test switch to the original configuration (or all switches Open).

   For patient temperature alarm-difference setting greater than 0.5 degree C:

   Switch #1, #2 should be closed (On)

   Switch #3, #4 should be open (Off).

6. Replace the back panel.

Controller Unit Testing Separate From Warmer

Note: If required, the controller unit can be tested separately from the warmer. The following test load may be connected in place of a heater assembly.

1. With the power switch Off connect the controller assembly to a test load as follows:

2. Between J17 pin 3 (phase) and J17 pin 1 (heater N) connect a 400 watt resistive load for 115 Vac.

3. Between J17 pin 3 and J17 pin 2 (alarm light N) connect a 12 watt resistive load for 115 Vac.

4. Between pin 1 and pin 3 of the observation light connector, place a 50 watt resistive load for 12 Vac.

4.5 Gas Regulator Check

1. Turn supplies, disconnect the gas pipeline connection, and attach a cylinder to each manifold.

2. Connect the regulator setting tool (.025 in. orifice open) to the power outlet, open cylinder slowly and check for the correct regulator setting per table below. Adjust the regulator as necessary.

Cylinder	Outlet Pressure
2000 psig (36 bar)	49.5 ±2 psig (3.37 ± .14 bar) (with .025" orifice bleed)
1500 psig (102 bar)	52.0 ±2 psig (3.54 ± .14 bar) (with .025" orifice bleed)
1000 psig (68 bar)	54.0 ±2 psig (3.67 ± .14 bar) (with .025" orifice bleed)
750 psig (51 bar)	55.0 ±2 psig (3.74 ± .14 bar) (with .025" orifice bleed)

3. Check the system for leaks according to procedure in section 5.8.G.

4.6 Electrical Safety Check

A. Leakage Current

Use approved equipment and techniques to test the unit's leakage current and ground continuity. Follow the directions supplied by the test equipment manufacturer to verify the following:

1. Less than 100 microamperes measured at any exposed metal surface for equipment rated at 120 Vac, 50/60 Hz.

2. Less than 200 microamperes measured at any exposed metal surface for equipment rated at 220 Vac, 50/60 Hz, 230 Vac, 50/60 Hz or 240 Vac, 50/60 Hz.

3. On elevating models, repeat the leakage current test while raising and lowering the bed to ensure that the leakage current remains within limits

B. Ground Resistance Check

Use a low range ohmmeter or electrical safety analyzer to measure the resistance between the ground pin on the line cord plug and exposed metal of the warmer. The ground resistance must be less than 0.2 ohms.

Note: Higher readings may indicate loose or oxidized connections in the power cord or grounding circuits.

4.7 Bed Motor Raise and Lower Test (Elevating Models Only)

1. Press the Raise Bed switch.
   a. Ensure that the bed elevates smoothly.
   b. Ensure that the motor continues operating with a over riding clutch action at the upper limit (~46-1/2 inches, or 118 cm, from the top of the mattress to the floor).

2. Press the Lower Bed switch.
   a. Ensure that the bed lowers smoothly.
   b. Ensure that the motor continues operating with a over riding clutch action at the lower limit (~38-1/2 inches, or 98 cm, from the top of the mattress to the floor).
   c. Verify operation of bed foot switches (if present).

CAUTION ⚠ On elevating models, do not continue to run the motor at upper and lower limit positions; equipment damage may result.

WARNINGS

⚠ Before any disassembly or repair, disconnect the electrical power and the gas line supplies. Remove any gas cylinders.

⚠ After completing a repair, the appropriate calibration procedure must be performed. After completing any portion of the calibration and adjustments procedures, perform the Checkout Procedure to make sure the Infant Warmer System is in proper operating condition. In addition, a final electrical safety check and leakage current test must be performed. If the unit fails any steps of the Checkout Procedure it must be removed from service and repaired. Record the information for future reference.

Use the Static Control Work Station to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

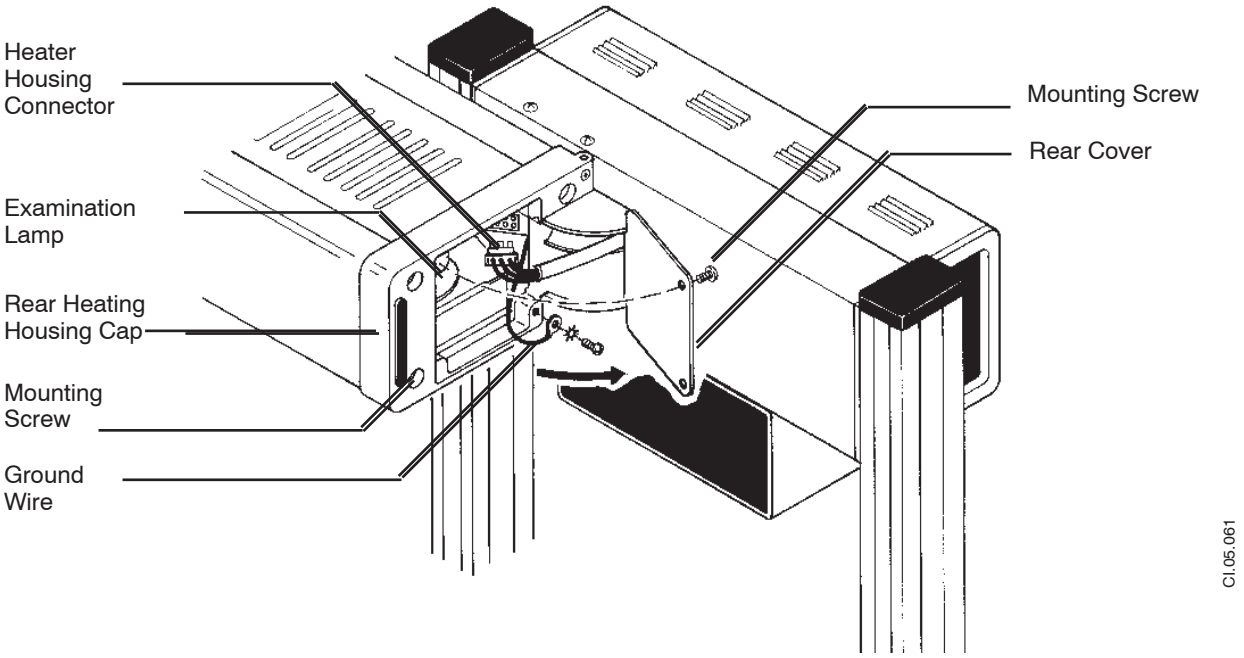


Figure 5-1
Removal of Back Cover from Heater Assembly

5.1 Heater Module Repairs

A. Heater Housing Disassembly

(See Figures 5-1 and 5-2)

1. Disconnect the Infant Warmer System Power Cord.
2. Rotate the heater to the X-ray position.

3. Remove the two Phillips head mounting screws for the back cover, and remove the cover (some older units have three screws securing the cover).

4. Disconnect the heater housing connector. Squeeze the locking tabs on the rear of the plug to disengage the lock mechanism.

5. Remove the ground wire for the heater housing.

For with HAK, AAN, HAJ and HCA serial numbers

6a. Remove the four mounting screws for the front cover plate and remove the plate.

b. Remove the four mounting screws for the front heater housing cap and remove the cap.

For units with the HCC serial number

6a. Remove the screw and lockwasher from the top of the cushioned heater head, then remove the screw and alarm light lens from the bottom of the heater head. Now the heater head can be pulled off the front of the unit.

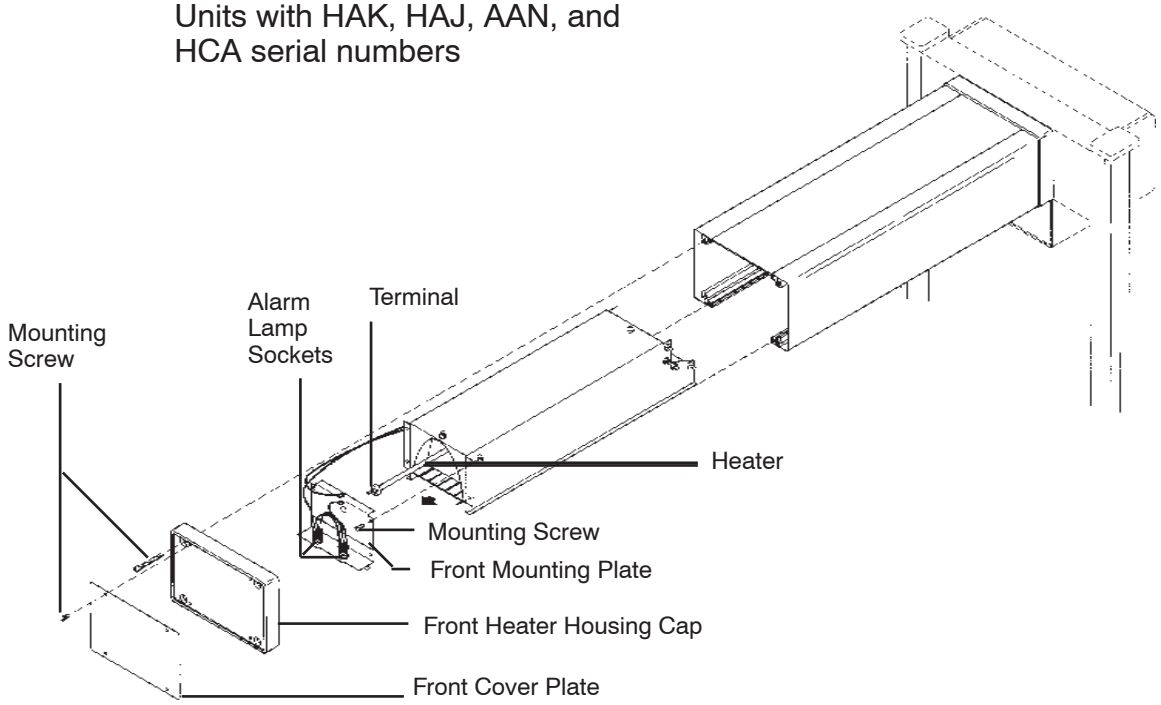
b. Remove the four screws from the end cap support plate and remove the plate.

7. Push the heater assembly out the front of the heater housing. Avoid bending the rear of the heater assembly.

8. To make disassembly easier, the four mounting screws for the rear heater housing cap may be loosened. Do not entirely remove the mounting screws.

   Note: The heater, alarm lamp sockets, examination light socket, and wiring harness can be replaced when the heater assembly is removed.

Units with HAK, HAJ, AAN, and HCA serial numbers



Units with HCC serial number

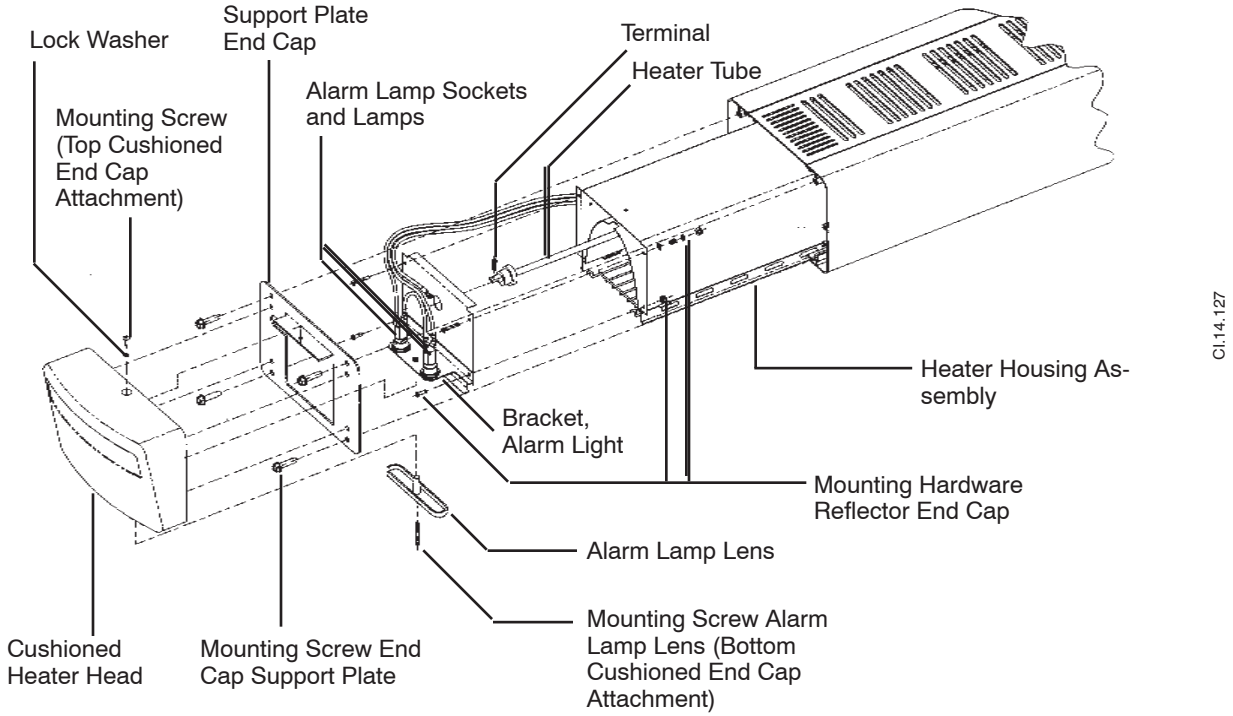


Figure 5-2
Heater Housing Assembly

B. Heater Replacement

(See Figure 5-2)

WARNING ⚠ Disconnect the power to the warmer and allow the heat tube to cool before cleaning or replacement to avoid the possibility of a burn.

CAUTION ⚠ During heater rod removal or replacement, hold terminal to ensure no strain is placed on the element.

1. Hold each terminal on the heater rod to ensure no strain is placed on the element while removing the heater wire connection screws from both ends of the heater.
2. Remove the four mounting bolts for the front mounting plate and move it to the side.
3. Slide the heater rod out from the front of the heater assembly.
4. Slide the replacement heater rod in from the front of the heater assembly.

WARNING ⚠ The replacement heater tube must match your unit. Earlier units have 440 Watt Heaters. Newer units, with serial number beginning with HCA and HCC, have a 540 Watt heater. Installing the new 540 Watt heater tubes in the older units with HAK,HAJ and AAN serial numbers may shorten the life of the power supply board. Check the serial number located on the back panel of the display module against the parts listed in 7/Illustrated Parts to verify you have ordered the correct replacement part.

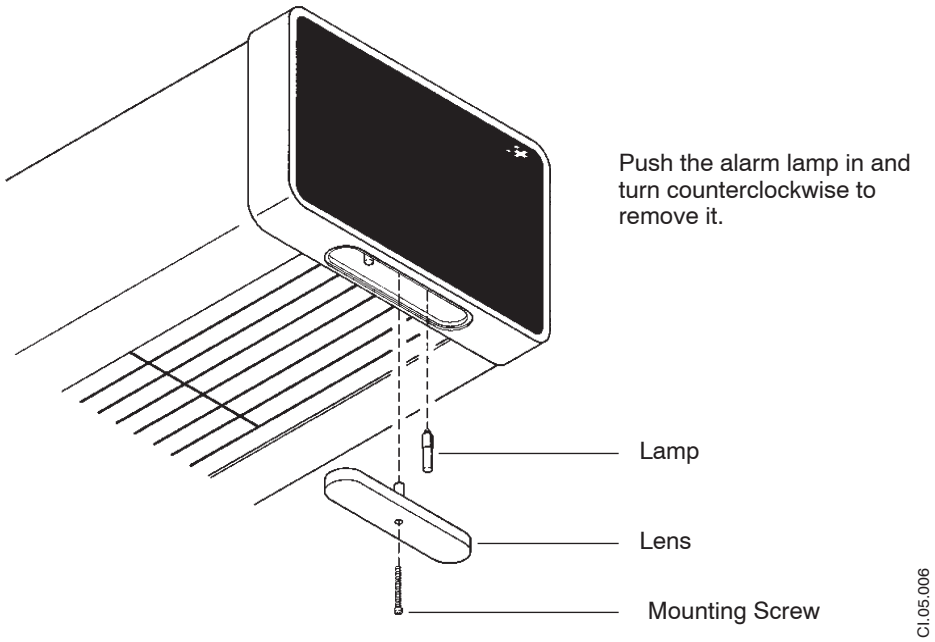
5. Hold each terminal on the heater rod to ensure no strain is placed on the element while replacing the heater wire connection screws on both ends of the heater. Tighten the screws to 12 - 14 lb.-in.
6. Place the front mounting plate in position and replace the four mounting bolts.

C. Heater Housing Assembly

(See Figures 5-1 and 5-2)

1. To reassemble, reverse step 1 through 8 in section 5.1.A, Heater Housing Disassembly.

Units with HAJ, HAK, AAN, and HCA serial numbers



Units with HCC serial Number

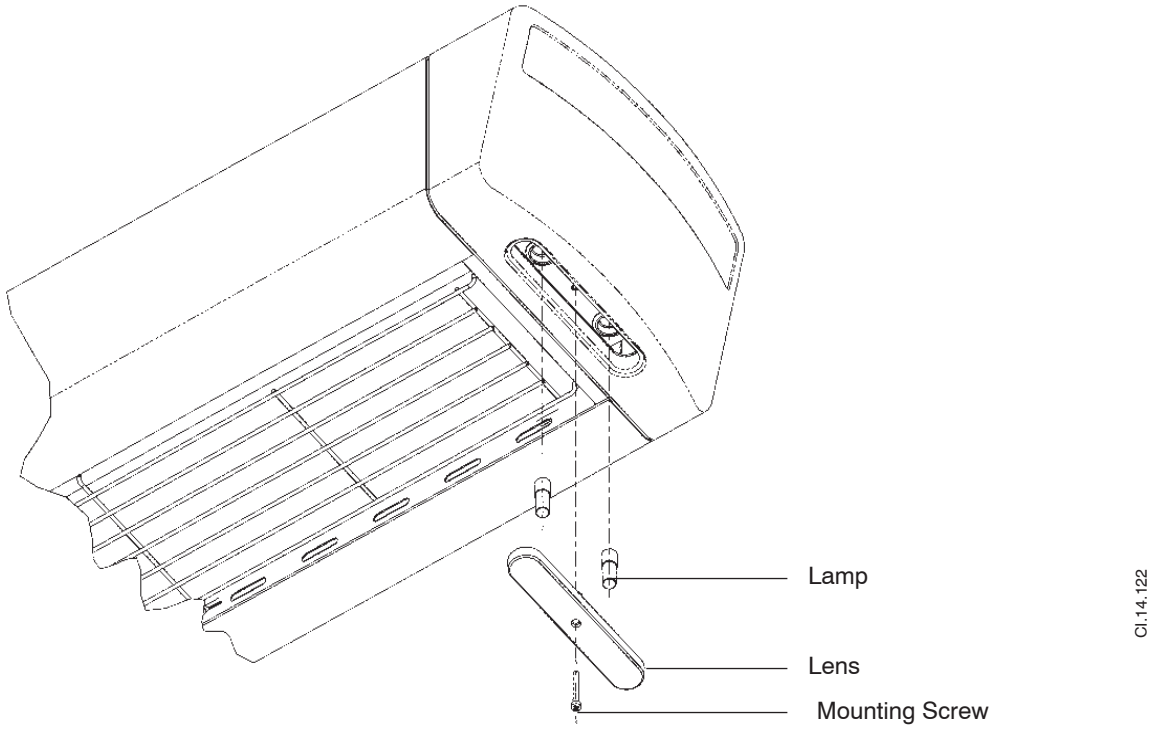


Figure 5-3
Alarm Light Replacement

2. Perform the electrical safety procedures in Section 4 and all the checkout procedures in Section 2.2.

D. Alarm Lamp Replacement

(See Figure 5-3)

Lamp: GTE Sylvania 120MB 6W

WARNING ⚠ Disconnect the Infant Warmer System power cord and allow the unit to cool before replacing the alarm light.

1. Disconnect the Infant Warmer System power cord and allow the unit to cool for 10 minutes.
2. Use a Phillips head screwdriver and remove the lens mounting screw located in the center of the alarm light.
3. Remove the lamp by pushing in and turning it counterclockwise.
4. Install the new lamp by pushing in and turning it clockwise.

   Note: When one lamp burns out it is recommended to replace both lamps. Replacing both lamps ensures maximum reliability.
5. Place the lens cover in position and secure it with the mounting screw.
6. Plug the power cord in and perform the checkout procedures detailed in Section 2.2.

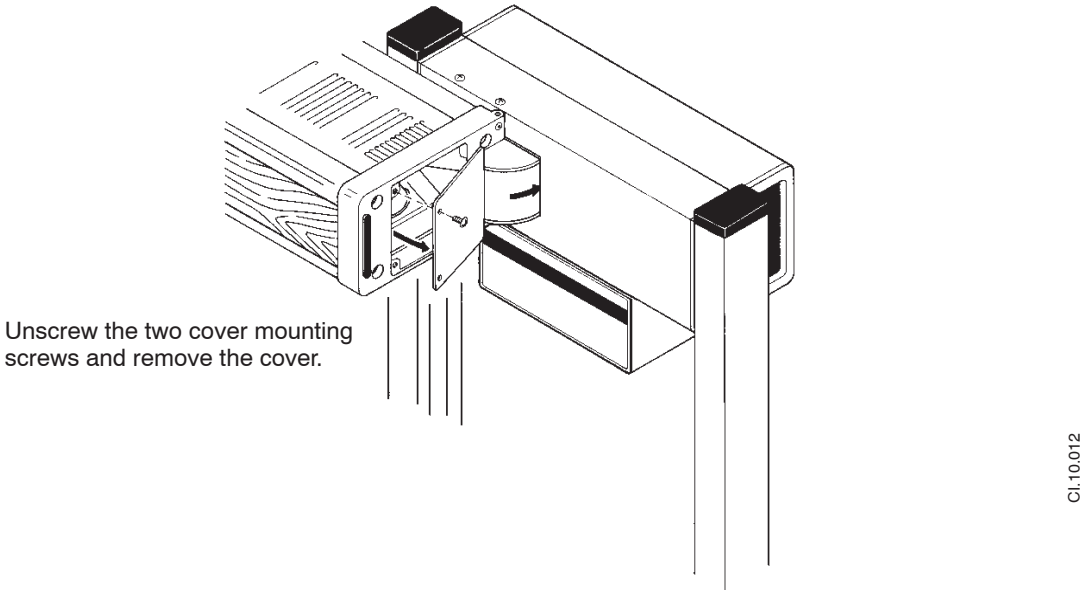


Figure 5-4
Observation Lamp Cover Removal

E. Observation Lamp Replacement

(See Figures 5-4 and 5-5)

Lamp: GE EXZ (Q50 MR16/NFL)

GE EXN (Q50 MR16/FL)

WARNING ⚠ Disconnect the Infant Warmer System power cord and allow the unit to cool before replacing the observation light. The lamp normally operates at a high temperature.

Note: Do not touch the center glass bulb. This will reduce the life of the lamp.

1. Disconnect the power cord for the warmer and allow the unit to cool for 10 minutes.
2. Rotate the heater assembly to the X-ray (side) position.
3. Use a Phillips head screwdriver to remove the two back panel mounting screws and remove the back panel (some older units have three screws).
4. While holding the lamp with one hand, use the other hand to pull the lever (next to the lamp) forward and remove the lamp.
5. Place the new lamp in position and push it into the lamp socket.
6. Replace the back panel and mounting screws.
7. Rotate the heater assembly back to the normal operating position.
8. Plug the power cord in and perform the checkout procedure detailed in Section 2.2.

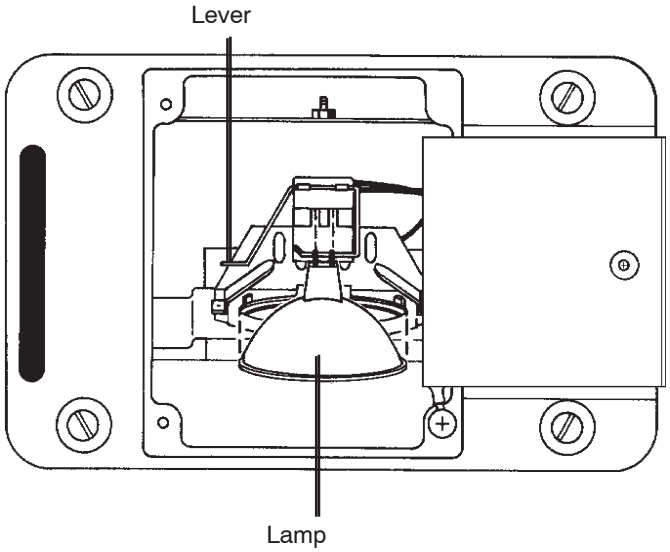


Figure 5-5
Observation Lamp Replacement

5.2 Control Module Repairs

A. Control Module Removal

(See Figure 5-6)

1. Disconnect the Infant Warmer System power cord.
2. Remove the two center mounting screws from the bottom of the display module.
3. Remove the two mounting screws for the control unit cover and remove the cover. Fold the ESD shield (if present) down away from the control board.
4. On models with HAK, HAJ and AAN serial numbers, disconnect the two connectors, J17 and the three pin connector for the observation light to the right of the power board (on elevating models, J16 must also be disconnected). Squeeze the locking tabs on the back of the plug to disengage the locking mechanism.

   On models with the HCA and HCC serial number, disconnect three connectors: the one that connects the heater wire harness (W2, P3) to the power supply board (A1, J17); the one that connects the heater wire harness (W2, P4) to the transformer (W1, J4); and the one that connects the heater wire harness (W2, P2) to the solid state relay (W3, P2). On elevating models, connector W8, P2 must also be disconnected.

   On elevating models with foot switches, disconnect the footswitch upright cable (W13, P1) from the controller footswitch cable (W12, J1).

   Refer to the wiring diagrams in Section 8 to check proper connections.
5. Loosen the four corner mounting screws for the control unit and carefully remove the control module. Place the control unit on a flat surface so it rests on the transformers.

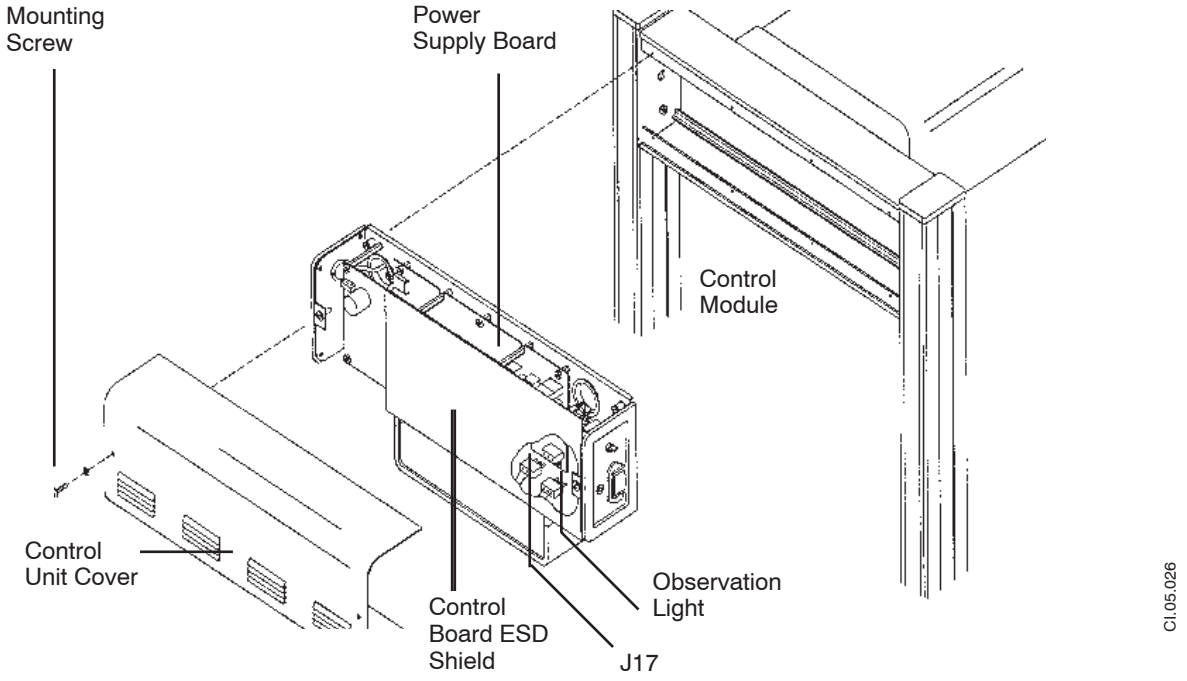


Figure 5-6
Control Module Assembly

B. Control, Power Supply and ThermaLink Board Replacement

(See Figure 5-7)

CAUTION

⚠ When removing cables, always grasp the connector on the sides and gently remove the cable connector from the board. This will prevent weakening of the cable assembly. Never remove the connector by pulling on the cable.

Control Board Removal

1. Disconnect the power cord.

2. Disconnect the four connectors (J1, J5, J6, and J7) from the control board. Disengage the locking tab on the connector by inserting a small screwdriver between the tab and the rear of the connector plug. Grasp the sides of the connector and gently remove the connector plug from the controller board.

3. If the ThermaLink option is installed, disconnect connector J9. Grasp the sides of the connector and gently remove the connector plug from the controller board.

4. Use a 5/16 inch socket to remove the six mounting nuts and three flat washers, if present, for the control board.

5. Remove the control board.

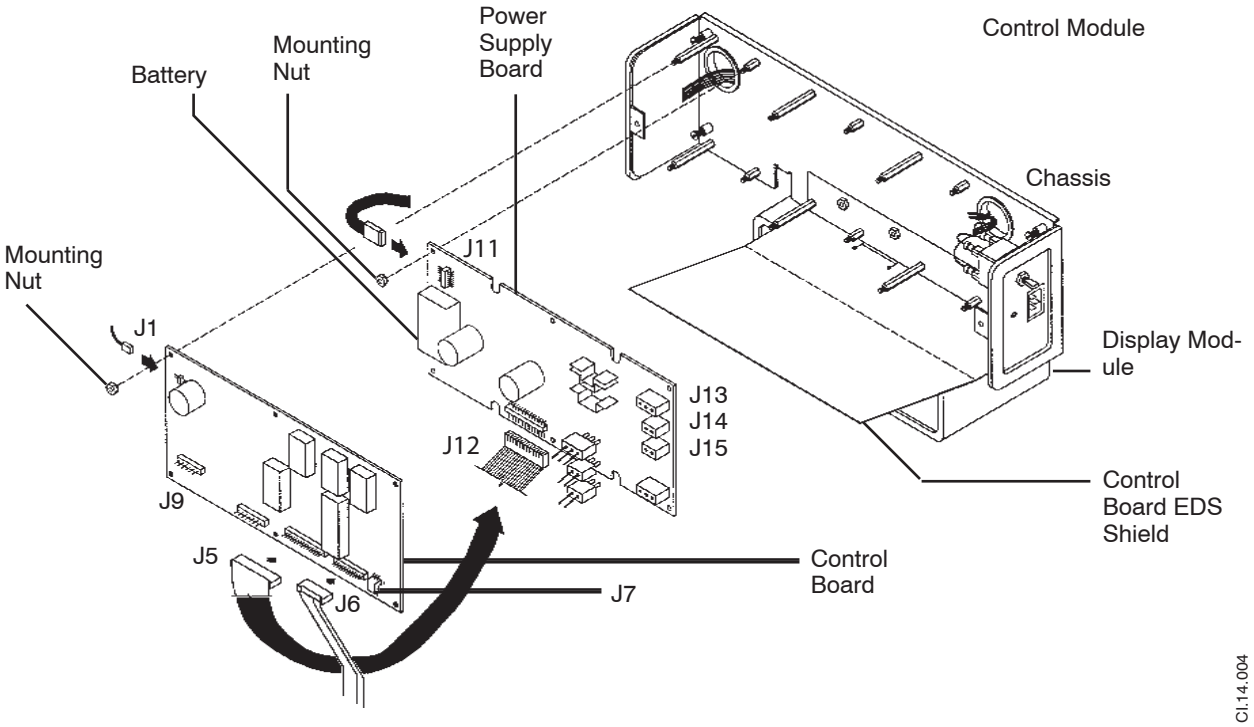


Figure 5-7
Control Board and Power Supply Board Assembly

Power Supply Board Removal

Note: Remove the Control Board first.

1. Disconnect connectors J11 and J12 from the power supply board. Disengage the locking tab on the connector by inserting a small screwdriver between the tab and the rear of the connector plug. Grasp the sides of the connector and gently remove the connector from the power supply board.

2. Disconnect connectors J13, J14, J15, and J17 (also disconnect J16 on elevating models) from the power supply board. Squeeze the locking tabs on the rear of each connector plug to disengage the lock mechanism.

3. Use a 5/16 inch socket to remove the six mounting nuts for the power supply board.

4. Remove the power supply board.

ThermaLink Board Removal

Note: There are two versions of the ThermaLink board. The older version has a test switch (SW1) on the board and is held in place by four screws. The newer version has no test switch and is held in place by two screws.

1. Remove the two mounting screws from the ThermaLink cover. Slide the ThermaLink cover back away from the chassis. Disconnect the ThermaLink external connector cable attached to the cover from connector J31on old version or JP1 on new version of the ThermaLink board. Grasp the sides of the connector and gently remove the connector plug from the ThermaLink board. Remove the cover and set aside.

2. Disconnect connector J9 from the control board. Grasp the sides of the connector and gently remove the connector plug from the controller board.

3. Loosen the four ThermaLink chassis mounting screws from the left hand side of the controller chassis and remove the ThermaLink chassis from the controller taking care not to damage the ThermaLink to control board ribbon cable. On some units, it may be necessary to completely remove the ThermaLink chassis mounting screws prior to removing the ThermaLink chassis from the controller.

4. Disconnect ribbon cable connector from J30 on old version or JP2 on new version of the ThermaLink board. Grasp the sides of the connector and gently remove the connector plug from the controller board.

5. Remove the ThermaLink board mounting screws using a Phillips screw driver and remove the ThermaLink board.

ThermaLink Board Installation

1. Place the new ThermaLink board in position on the four ThermaLink chassis mounting posts.

2. Replace the mounting screws for the ThermaLink board.

3. Reconnect ribbon cable connector J30 on the old version or JP2 on the new version of the ThermaLink board.

4. Place the assembled ThermaLink chassis in position against the left side of the controller chassis taking care not to pinch the ribbon cable, and tighten the four mounting screws. On some older units, it may be necessary to remove the mounting screws and thread them through the holes in the controller chassis.

5. Reconnect ribbon cable connector J9 to the control board.

6. Reconnect the external ThermaLink cable, attached to the ThermaLink cover, to connector J31 on the old version or JP1 on the new version of the ThermaLink board.

7. Place the ThermaLink cover in position and replace the two mounting screws.

8. Perform the electrical safety and the calibration procedures in Section 4. Perform the checkout procedures detailed in Section 2.2.

Power Supply Board Installation

1. Place the new power supply board in position on the six mounting posts.

2. Replace the six mounting nuts for the power supply board.

3. Reconnect connectors J11, J12, J13, J14, J15, J16 (applicable to elevating models) and J17 to the power supply board.

Control Board Installation

1. Place the control board in position on the six mounting posts.

2. Replace the six mounting nuts and three flat washers, if present, for the control board. See figure 5-7.

3. Reconnect the four connectors (J1, J5, J6, and J7) to the control board.

4. If the ThermaLink Option is installed, reconnect the J9 connector to the control board.

5. Perform the electrical safety and the calibration procedures in Section 4. Perform the checkout procedures detailed in Section 2.2.

C. Display Module Disassembly

(See Figures 5-8 and 5-9)

CAUTION

⚠ When removing cables, always grasp the connector on the sides and gently remove the cable connector from the board. This will prevent weakening of the cable assembly. Never remove the connector by pulling on the cable.

1. Disconnect the power cord.

2. Remove the 4 bottom cover screws from the Display Module.

3. Slide the bottom cover down from the top cover.

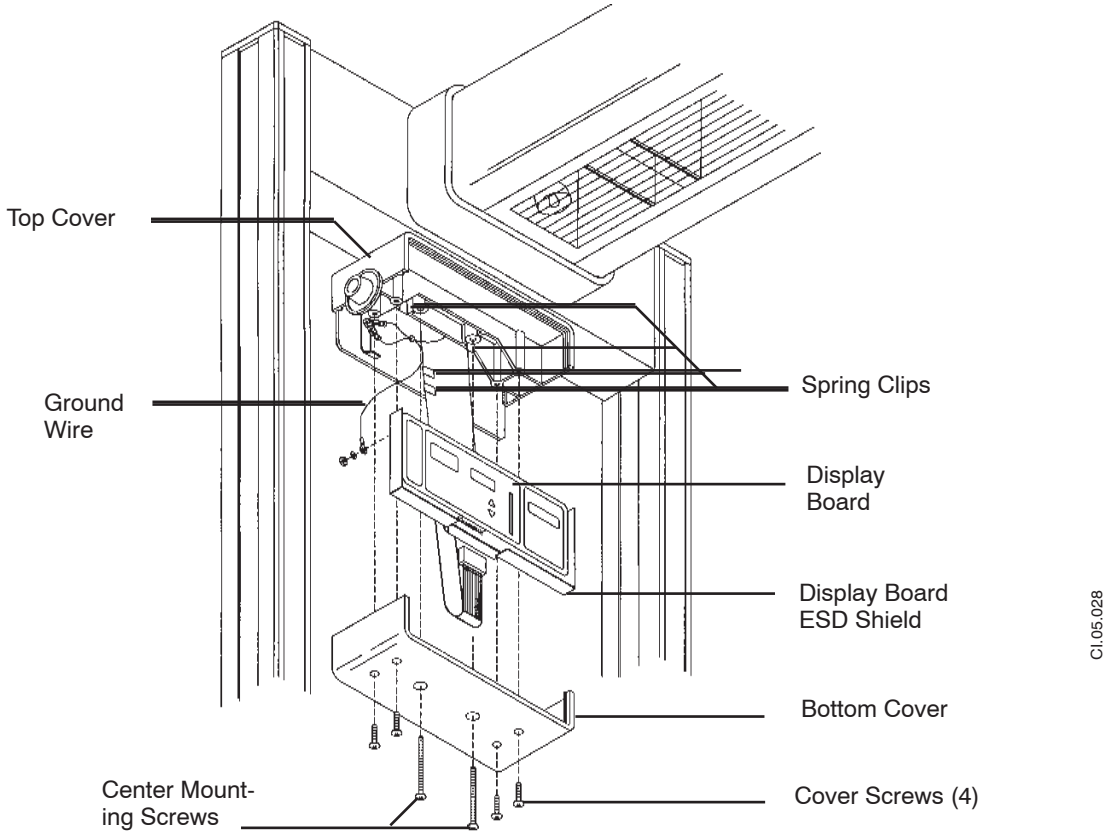
4. Slide the display board out of the cover.

5. Disconnect the ground wires (if present) from the bottom cover by pulling the two fastons off.

6. Remove the 5 mounting nuts from the back of the display board. Remove the flat washers, lock washers, and the ground wire (if present). See Figure 5-9.

7. Remove the ESD shield (if present) and ten flat washers (if present) from the mounting posts. Separate the display board from the display panel.

8. Disconnect the 12 pin connector (J22) from the display board taking care not to damage the ESD shield. Disengage the locking tab on the connector by inserting a small screwdriver between the tab and the rear of the connector plug. Grasp the sides of the connector and gently remove the connector from the display board. On elevating units with HCC serial number, disconnect the controller footswitch cable from the display panel (W12, P1).



Note: ESD shield and spring clips not present on all units.

Figure 5-8
Display Module Assembly

D. Display Module Assembly

(See Figures 5-8 and 5-9)

1. Place the display board on the display panel mounting posts.
2. For units with the ESD shield present, place the 10 flat washers over the threads of the mounting posts, then replace the ESD shield.

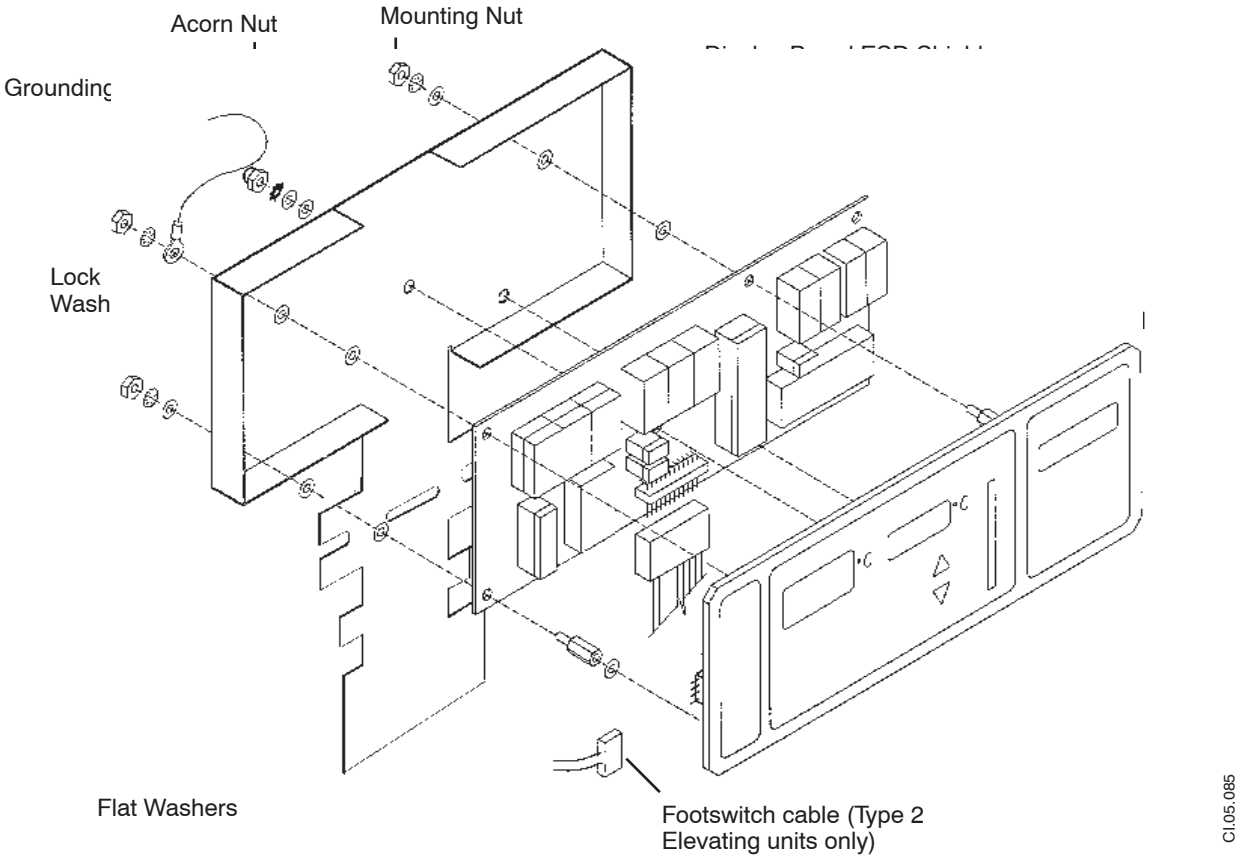


Figure 5-9
Display Board Assembly

3. For units with the ESD shield present, replace the 3 flat washers, 3 lock washers and mounting nuts on all the standoffs except the grounding post and the center stand-off.

4. For units without the ESD shield present, replace the 4 lock washers and mounting nuts on all the standoffs except the grounding post.

5. Replace the ground wire (if present), internal tooth lock washer and mounting nut on the grounding post.

6. For units with the ESD shield present, replace the two flat washers, external tooth lock washer and acorn nut on the center stand-off On HCC elevating units, reconnect the controller footswitch cable to the display panel.

7. Connect the 12 pin connector J22 from the control board to the display board. Ensure that the locking tabs are engaged.

8. Slide the display board into the top cover.

9. Connect the ground wires (if present) to the back cover plate.

10. For units with the ESD shield present, check that all 4 spring clips are in place and holding the foil covered ribbon cable securely to the ESD shield. See figure 5-10.

11. Slide the bottom cover and back panel into the top cover. Be sure that the display and back panel are aligned in the slots, and that you push up evenly on all four corners of the display module.

12. Replace the 4 bottom cover mounting screws for the display panel.

13. Perform the electrical safety and the calibration procedures in Section 4. Perform the checkout procedures detailed in Section 2.2.

E. Control Module Replacement

(See Figure 5-6)

1. Carefully place the control module in position and tighten the four mounting screws for the control unit.

2. Reconnect the two connectors, J17 and the three pin chassis connector to the right of the power board (on elevating models, J16 must also be connected), to the power supply board. On IWS model 5000 and newer models with Serial Numbers starting with HCA and HCC, reconnect J14 to the solid state relay. If present, reconnect cable W3, P2 connecting the solid state relay to the heater wire harness (ref. Wiring diagram in Section 8 of Service Manual).

3. Hold the display module in position and replace the two inside mounting screws on the bottom of the module.

4. For units with the ESD shield present, fold the ESD shield back up into place.

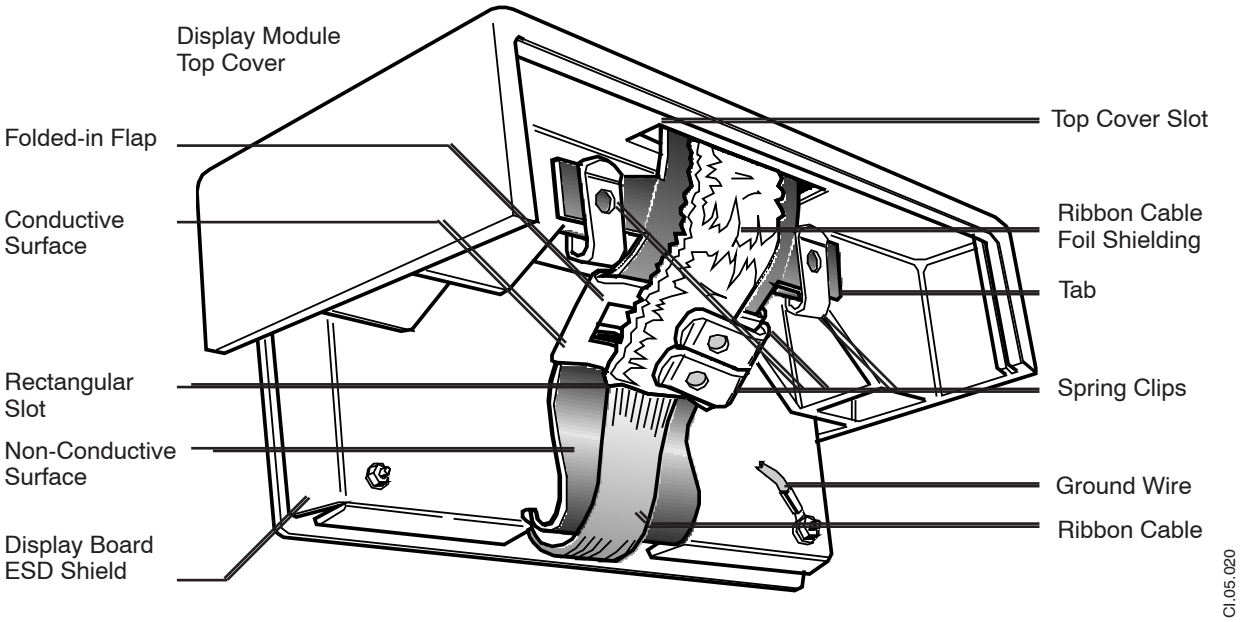


Figure 5-10
Ribbon Cable Grounding Diagram

5. Place the control unit cover in position and replace the two mounting screws.

6. Perform the electrical safety and the calibration procedures in Section 4. Perform the checkout procedures detailed in Section 2.2.

F. Battery Replacement

(See Figures 5-6 and 5-7)

The maintenance free battery should be tested regularly and the replacement schedule is every two years. Refer to Section 2.2B for testing the battery.

1. Disconnect the warmer power cord.

2. Remove the two mounting screws for the control unit cover and remove the cover. For units with the ESD shield present, fold the ESD shield down away from the control board.

3. Disconnect connector J1 from the control board. Disengage the locking tab on the socket by inserting a small screwdriver between the tab and the rear of the plug. You do not have to remove any other connectors.

4. Remove the 6 mounting nuts and 3 flat washers (if present) for the control board.

5. Slide the control board off the mounting posts and rotate it down.

6. Remove the battery and install a replacement battery. Ensure the positive and negative terminals are correctly engaged.

CAUTION: ⚠ Replace only with Ohmeda 7.2 V NI-CAD rechargeable battery.

7. Place the control board in position on the mounting posts.

8. Replace the 6 mounting nuts and 3 flat washers (if present) for the control board.

9. Reconnect connector J1 to the control board.

10. For units with the ESD shield present, fold the ESD shield back up into place.

11. Replace the two mounting screws for the control unit cover.

12. Perform the electrical safety procedures in Section 4 and the checkout procedures in Section 2.2.

G. Circuit Breaker Reset

The warmer is equipped with a combination power switch and manual resetting circuit breaker. If the circuit breaker trips the power switch is deactivated. To reset the circuit breaker return the switch to the “On” position. If the circuit breaker trips again, service is required.

5.3 Bed Platform Repairs Small and Large Bed Models (For Model 3500 see section 5.4)

A. Side Panel Replacement

(See Figure 5-11)

To remove a side panel, first lower the side panel then press the end pins in and lift the side panel out. To replace a side panel, hold the end pins in, place the side panel in position, and release the end pins. To lower the side panel, pull up and rotate away from the bed. To raise the side panel rotate it to the upright position, then allow it to engage in the latched position.

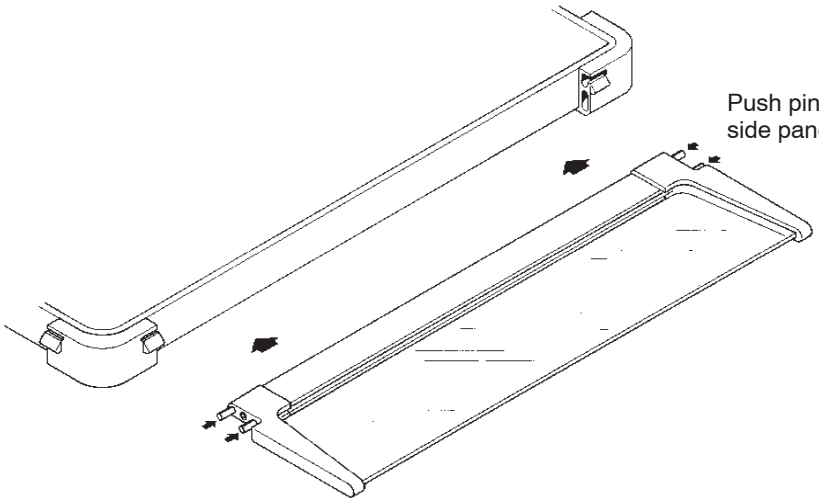


Figure 5-11
Side Panel Replacement

B. Side Panel Repairs

(See Figure 5-12)

Disassembly:

1. Remove the mounting screw from the end bracket.
2. Disassemble the end bracket, window, support button and spring from the bed side. You may need to heat the Loctite slightly to disassemble the end bracket.
3. Replace damaged parts as necessary.

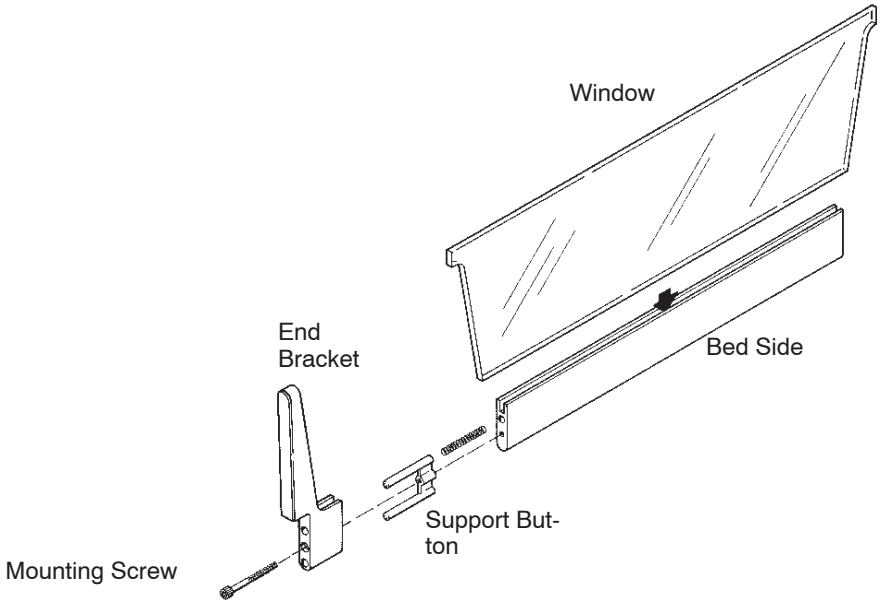


Figure 5-12
Side Panel Assembly

Assembly:

1. Mount the spring, support button, and end bracket on the bed side and window.

2. Replace the mounting screw and tighten securely.

C. Bed Platform Disassembly

(See Figure 5-13)

1. Remove the mattress and the clear plastic cover.

2. Remove the four side panels from the bed platform.

Note: Before removing the hydraulic cylinder on units with rotating drawer packages, the drawer package must first be removed. On units with the stationary drawer package installed, the top drawer must be removed for access to the hydraulic system mounting kit. See appendix.

3. Use a 1/2 inch wrench and 7/16 inch wrench to remove the hydraulic system mounting nut and stud from the lower support.

4. Use a No. 2 Phillips screw driver and remove the four retaining rods and hooks from the bottom of the bed platform.

5. Slide the two bed pivot rods out from each side.

6. Lift the bed platform off the lower support.

D. Bed Platform Assembly

(See Figure 5-13)

1. Place the bed platform in position on the lower support.
2. Insert the two bed pivot rods into position on the lower support. The notch must face the bed platform (upwards), and be positioned between the notches in the bed platform.
3. Use a No. 2 Phillips screw driver and install the four retaining rods and hooks (if present) on the bottom of the bed platform. The open end of the hooks should face away from the bed platform.
4. Use a 1/2 inch wrench and 7/16 inch wrench to install the hydraulic system mounting nut and stud on the lower support.

Note: Before removing the hydraulic cylinder on units with rotating drawer packages, the drawer package must first be removed. See appendix.

5. Replace the four corner blocks and eight O-rings, if present, on the bed platform.
6. Replace the four side panels on the bed platform.
7. Replace the clear plastic cover.
8. Replace the mattress.
9. Perform checkout procedure in section 2.2.

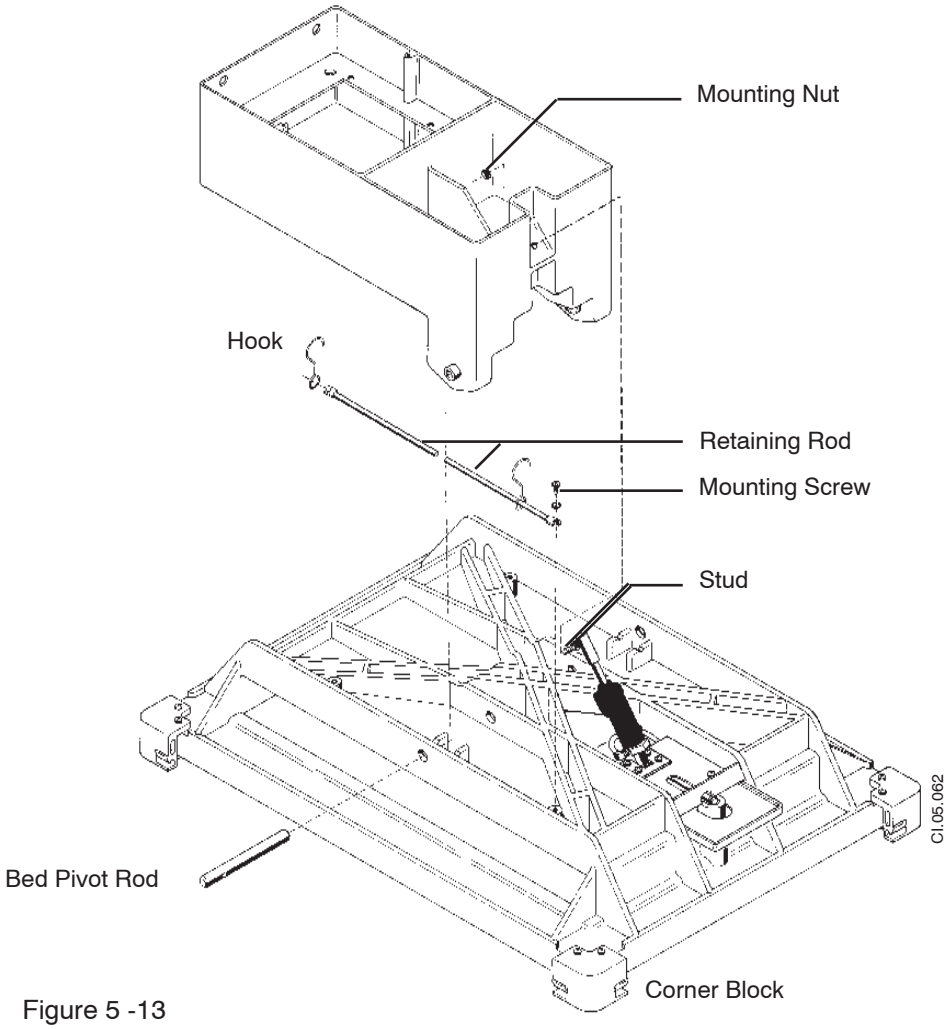


Figure 5 -13
Bed Platform Assembly

E. Hydraulic System Removal

(See Figures 5-14 and 5-15)

Note: Before removing the hydraulic cylinder on units with rotating drawer packages, the drawer package must first be removed. On units with the stationary drawer package installed, the top drawer must be removed for access to the hydraulic system mounting nut. See appendix.

WARNINGS

⚠ Before any disassembly or repair disconnect the power supply, gas pipeline supply connections, remove any gas cylinders and remove any accessories from the uprights.

⚠ When lowering or lifting the Infant Warmer System to and from the floor for inspection or repair, use two people for safety. Always ensure that you lay the unit on its right side (as viewed from the front) when laying the unit down. The heater/lamp housing does not lock and pivots to the left for access.

The unit may be carefully placed on it's right side (looking from the front), or the bed may be removed for replacement of the hydraulic system.

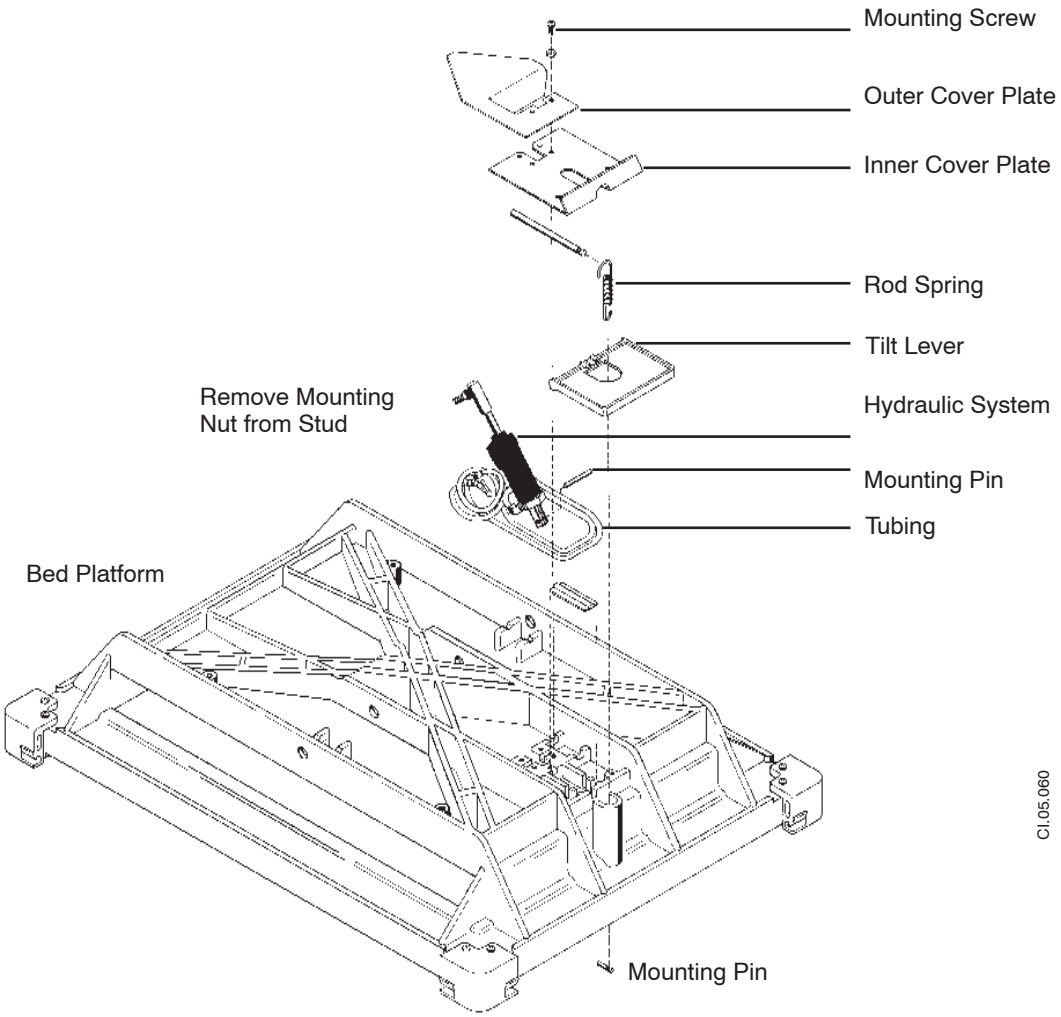


Figure 5-14
Hydraulic System Assembly

1. Use a 1/2 inch wrench and 7/16 inch wrench to remove the hydraulic system mounting nut and stud from the lower support.

2. Remove the two Phillips head mounting screws which hold the outer (triangular shaped) cover plate in position.

3. Remove the four Phillips head mounting screws which hold the inner (square shaped) cover plate in position. Ensure that the tension on the spring is released carefully.

   Note: The tilt lever, rod, spring, and mounting pin can be removed for replacement if necessary. Remove the pin from the top of the bed to remove the spring and rod.

   Note: On large bed models, the outer and inner hydraulic cover plates are combined into a single component.

4. Make note of how the tubing is installed in parallel, and does not overlap until it reaches the storage area.

5. Remove the hydraulic system assembly for replacement.

F. Hydraulic System Installation

(See Figures 5-14 and 5-15)

1. Transfer the mounting pin from the old hydraulic cylinder to the new hydraulic cylinder.

2. Place the hydraulic cylinder with pin in position in the bed support casting.

3. Install the tubing for the hydraulic system in parallel and make sure it does not overlap until it reaches the storage area.

CAUTION

⚠ When servicing the bed hydraulic system, the tubing must not be stretched, pinched or kinked during reassembly. If the tubing is pinched, the bed will not tilt and damage and oil leaks may result.

4. On small bed units, place the inner (square shaped) cover plate in position. On Large bed units, place the single cover in position.

5. Install the two mounting screws closest to the tilt lever.

6. Install the two mounting screws closest to the cylinder at the edge of the cover plate.

7. Coil the tubing so it fits in the triangular area.

8. On small bed units, place the outer (triangular shaped) cover plate in position and replace the two Phillips head mounting screws.

9. Use a 1/2 inch wrench and 7/16 inch wrench to tighten the hydraulic system mounting nut and stud in place on the lower support.

Install the tubing for the hydraulic system in parallel and make sure it does not overlap until it reaches the storage area. The tubing must not be stretched, pinched or kinked during reassembly.

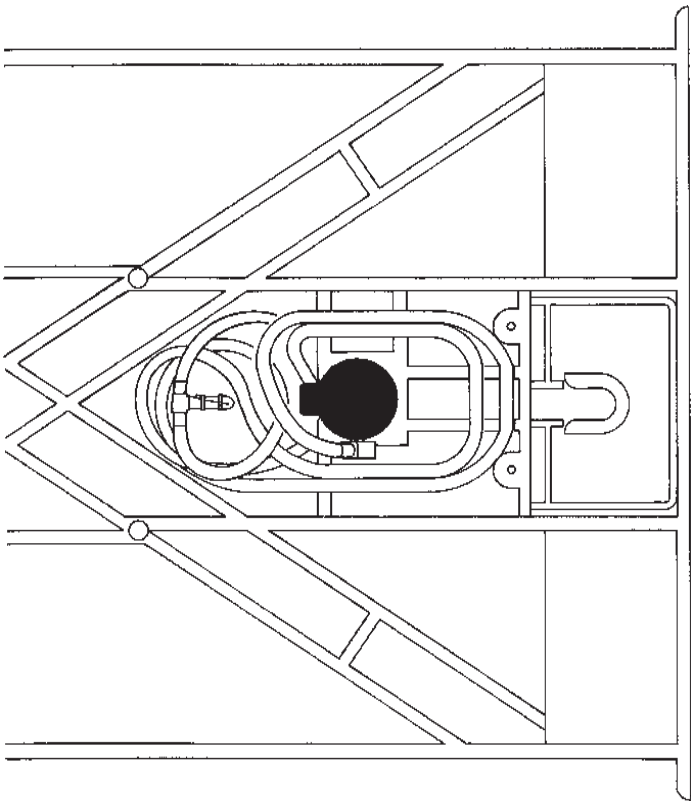


Figure 5-15
Hydraulic Tubing Installation

10. Re-install the rotating drawer package if previously removed.

11. Perform the checkout procedures in section 2.2.

5.4 Model 3500 Bassinet Bed Platform Repairs

A. Side Panel Replacement

(See Figure 5-11)

To remove a side panel, first unlock the ends by sliding the latch buttons outward to expose the red dots. Grasp the side panel, pull up and rotate away from the bed. Press the end pins in and lift the side panel out. To replace a side panel, verify the latch buttons are in the outward position exposing the red dots, hold the pins in, place the side panel in position and release the end pins. Grasp the side panel and rotate it to the upright position allowing it to engage in the latched position. Lock the ends by sliding the latch buttons inward to cover the red dots.

B. Side Panel Repairs

(See Figure 5-11 and 5-12)

Disassembly:

1. Remove the mounting screw from the end bracket.
2. Disassemble the end bracket, windows, support button and spring from the bed side.
3. Replace damaged parts as necessary.

Assembly:

1. Mount the spring, support button, and end bracket on the bed side and window.
2. Replace the mounting screw and tighten securely.
3. Perform the checkout procedures in section 2.2.

C. Bed Platform Disassembly

(See Figure 5-16)

1. Remove the mattress.
2. Remove the four side panels from the bed platform.
3. If necessary, remove the four corner blocks from the bed platform.
4. Using the handle, lower the front of the bed platform and lock in place.
5. Working from the rear of the unit, locate the collar on the left side of the pivot rod. Using a long 1/8" Allen wrench, loosen the set screw in the collar.
6. Grasping the entire bed platform, move it to the left so the shouldered spacers are no longer positioned in the indexing pivot bracket.
7. Pull the handle (forward) to release the indexing pins from the detents, grasp the entire bed platform and lift off the indexing pivot bracket.

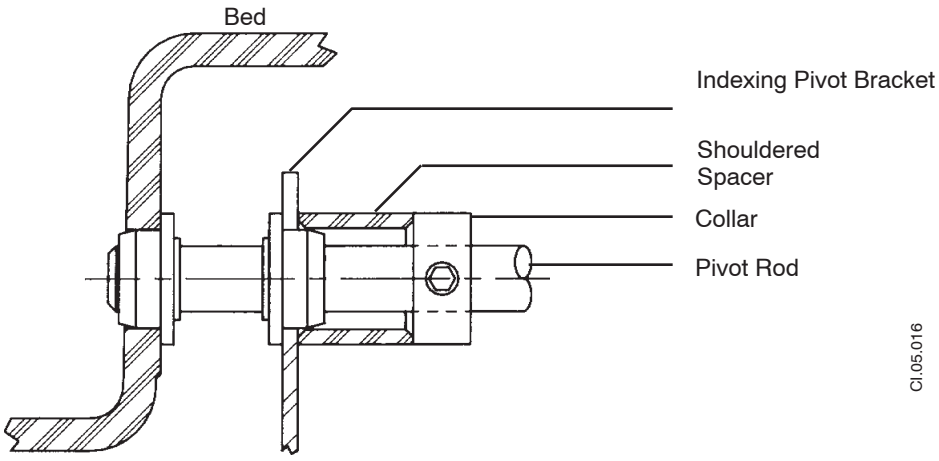


Figure 5-16
Bed Platform Pivot Rod, Spacer and Collar Assembly (Model 3500) as Viewed from the Rear

D. Bed Platform Assembly

(See Figure 5-16)

1. Place the bed platform on the indexing pivot bracket.
2. Pull the handle (forward) and place the indexing pins in the top detents. Release the handle.
3. Work from the rear of the unit. With the pivot rod in the indexing pivot bracket, move the bed platform to the left so the shoulder spacers are positioned in the indexing pivot bracket.
4. Using the handle (forward), lower the front of the bed platform and lock in place.
5. Slide the spacer and collar to the left, so the spacer is against the indexing pivot bracket.
6. Using a long 1/8" Allen wrench, tighten the set screw in the collar.
7. If they were removed, replace the four corner blocks on the bed platform.
8. Replace the four side panels on the bed platform.
9. Replace the mattress.
10. Perform the checkout procedures in section 2.2.

5.5 Model 3500 Bassinet Drawer Removal

The bassinet drawers may be removed from the bassinet cabinet for cleaning.

1. Pull the drawer out to its maximum travel.
2. The drawer slides (located between each drawer side and the cabinet) each have a release latch located on top of the slides. With your finger (or the blunt end of a pencil), reach in between the drawer and the cabinet and press down on the front edge of each latch to release them. Slide the drawer out of the cabinet.
3. To replace a drawer, insert the drawer slides into the cabinet tracks and close the drawer fully. The drawer latches will engage automatically when the drawer is closed.

5.6 Elevating Base Disassembly and Repair

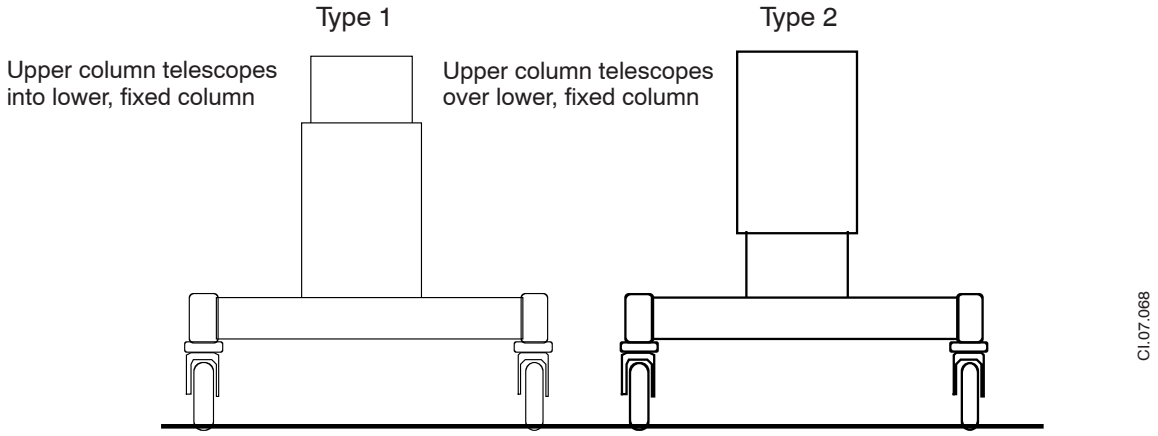


Figure 5-17
Elevating base types

A. Electric Motor/Jack-Shaft Disassembly and Re-assembly.

Type 1 units are shown in Figures 5-18 to 5-22. For Type 2 units, see Figures 7-11 and 7-12.)

WARNING ⚠ Before any disassembly or repair disconnect the power supply, gas pipeline supply connections, remove any gas cylinders and remove any accessories from the uprights.

General Disassembly Procedures

Note: This procedure requires two people, since the Infant Warmer is heavy and must be carefully laid on its right-hand side (as viewed from the front of the unit) during the operation. In order to replace the lift motor, phase capacitor, gear box/jack-shaft unit or motor power cable, the following steps are necessary.

WARNING

⚠ Lowering or lifting the Infant Warmer System to its side requires two people due to the size and weight of the unit.

⚠ Whenever the unit must be laid on its side for a repair procedure, lay it on the right side (as viewed from the front), the lamp-house assembly swings freely to the left and attempting to lay the unit on the left side could cause injury to a repair person or damage to the equipment.

1. Remove accessories from the uprights, the mattress, clear plastic panel, X-ray tray and side panels, as described in Section 5 C.

2. Remove the drawers of the unit.

3. Remove the cover plate from the bed support casting. See item 2, Figure 7-7.

4. Disconnect the motor cord plug and socket located inside the bed support casting. On units with HCC serial number, disconnect footswitch connector.

5. Remove the connector from the motor cord plug, or you can stretch the cord as you remove the baseplate and disconnect it at that end instead.

6. Remove the strain relief clamp around the motor cord and allow the cord to fall down inside the elevator column.

7. On Type 1 units, use a 1/2 inch wrench to remove the upper motor/jack-shaft mounting bolt and lock washer.

   On Type 2 units, use a 5/8 inch wrench to remove the upper motor/jack-shaft by removing the 2 hex nuts that secure it.

   Note: On Type 1 units, there is an external lock washer between the head of the bolt and the upper plate. There is also another lock washer, on the same bolt, under the plate between the top of the jack-shaft and the plate. See Figure 5-19.

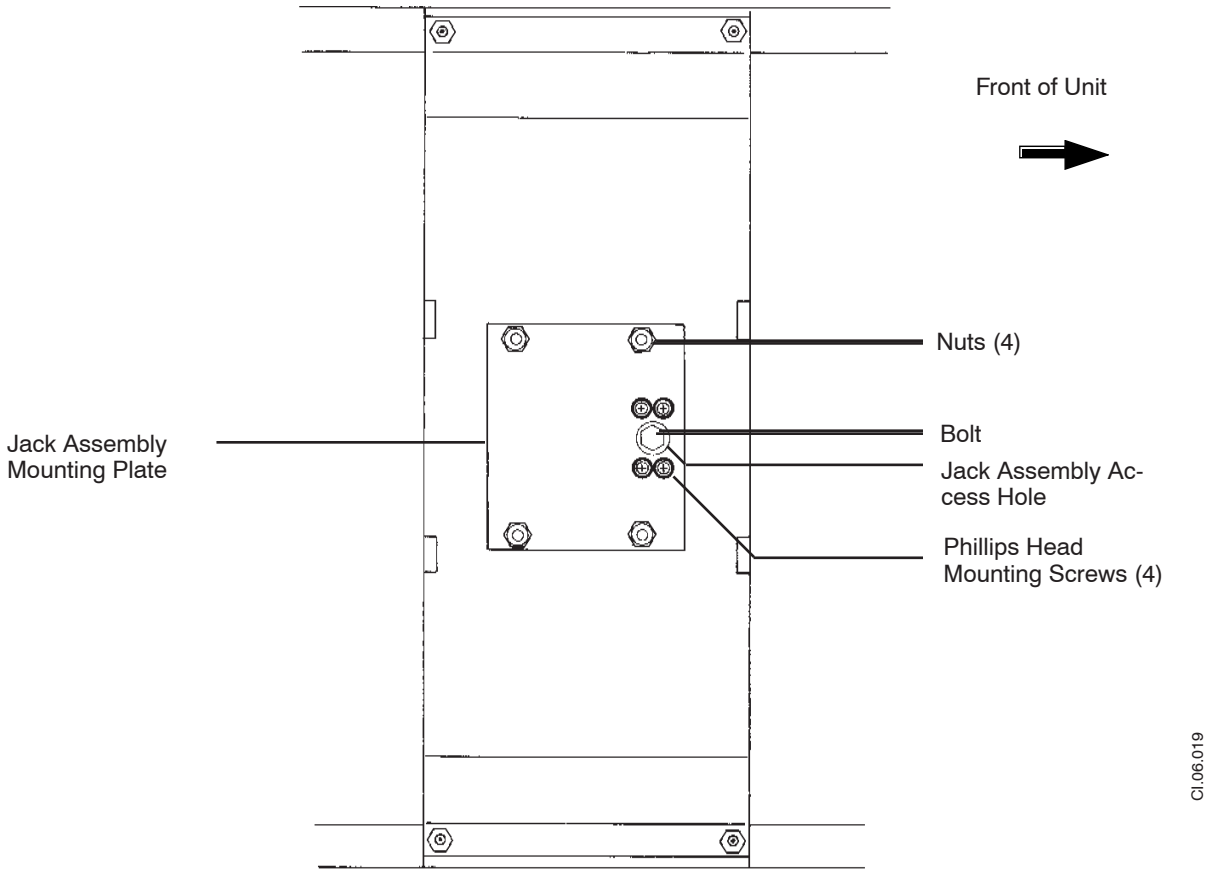


Figure 5-18
Bottom View of 5000 IWS (laying on its right hand side).

8. Carefully lay the warmer on its right-hand side, as viewed from the front.

9. Use a 1/2 inch wrench (or a 9/16 inch wrench on units with HCC serial number) to remove the four (4) 5/16-18 hex nuts and external lock washers from the assembly base plate. DO NOT REMOVE THE FOUR PHILLIPS HEAD SCREWS.

10. Pull out the base plate and the entire elevating assembly carefully; the ground wires and motor phase capacitor are mounted to the base plate.

    Note: The removal of the assembly requires some maneuvering. Gently pull the assembly out and turn it in a clockwise direction until the motor is located in the upper left corner of the access hole. Lifting outward on the bottom of the unit and gently maneuvering back and forth should allow the unit to be pulled out of the elevator column.

WARNING

⚠ When disassembling the elevating base, observe the following safety precaution to avoid electrical shock hazard from high voltage. Safely discharge the capacitor prior to removing any connectors.

11. Using an insulated screwdriver, carefully ground the phase capacitor to the base plate to remove any electrical charge and chance of shock.

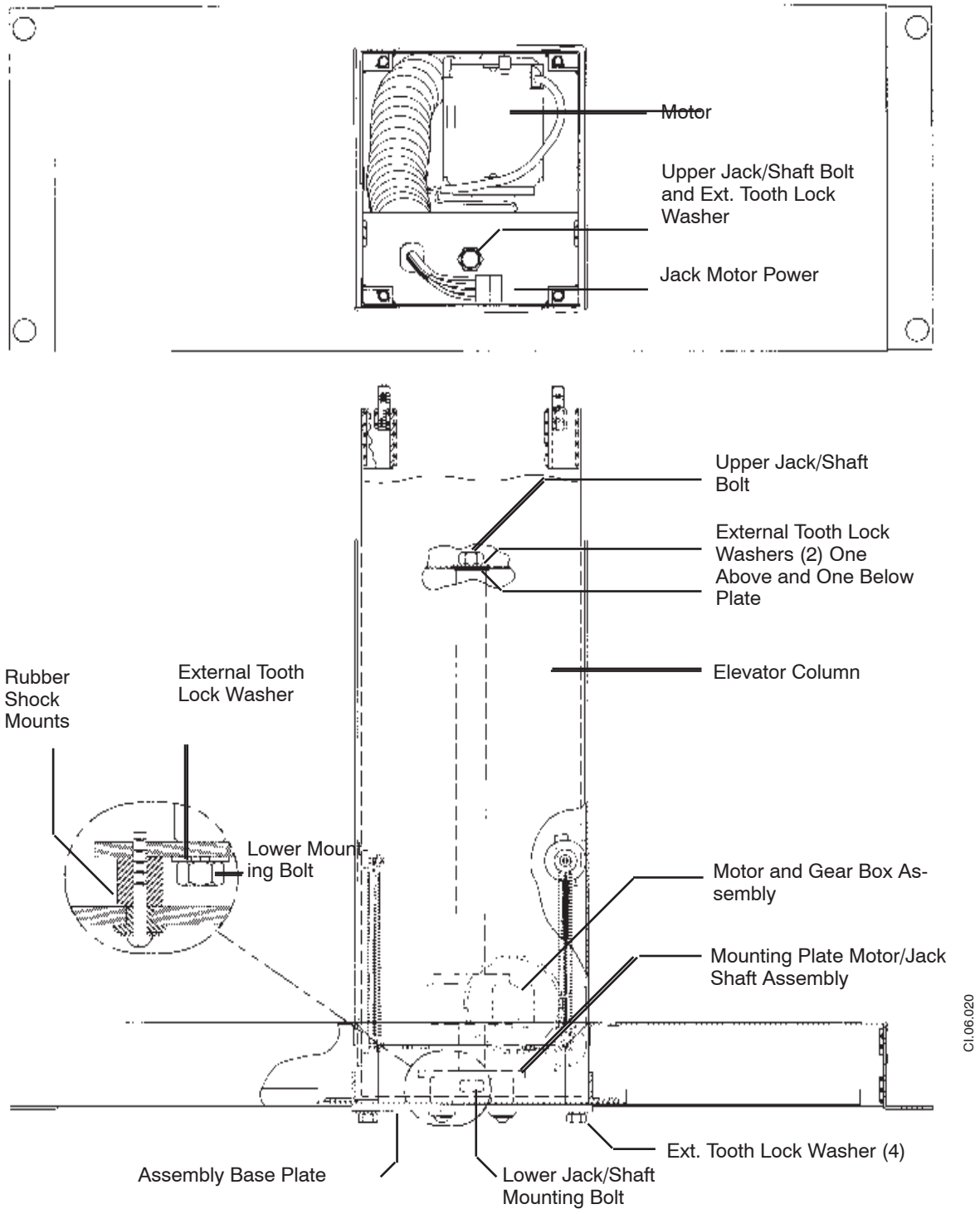


Figure 5-19
Top and Cut-away Internal Side View of Elevating System, Type 1 unit

12. On type 1 units, when the assembly is clear, check the top of the jack-shaft for the upper lock washer which may have stuck to the shaft. If the washer is there, remove it and set aside. If it is not, reach up the elevator column and remove it from the upper mounting bolt and set it aside.

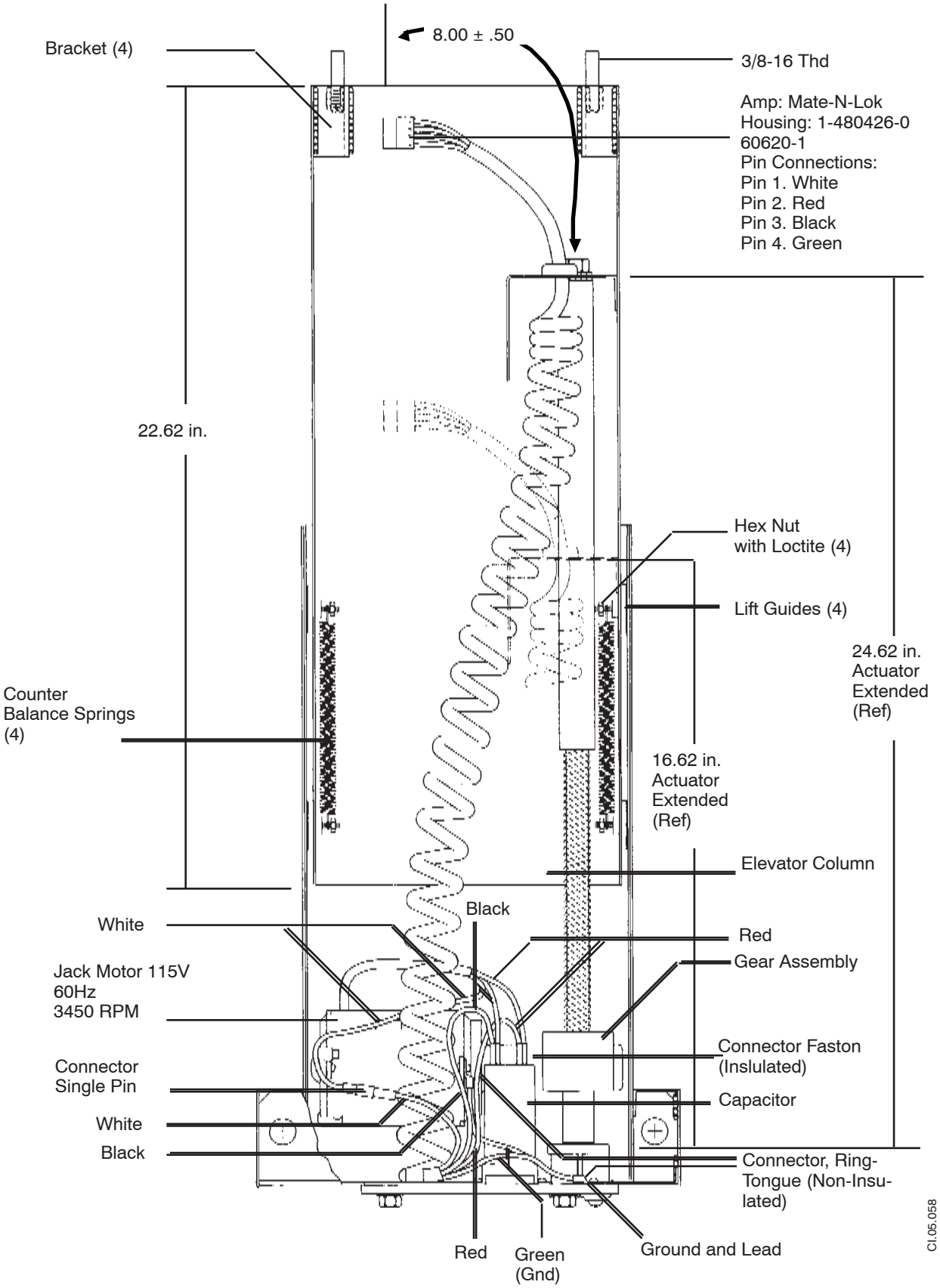


Figure 5-20
Cut-away, Internal Side View; Cable and Wiring Connections - (Type 1 unit shown)

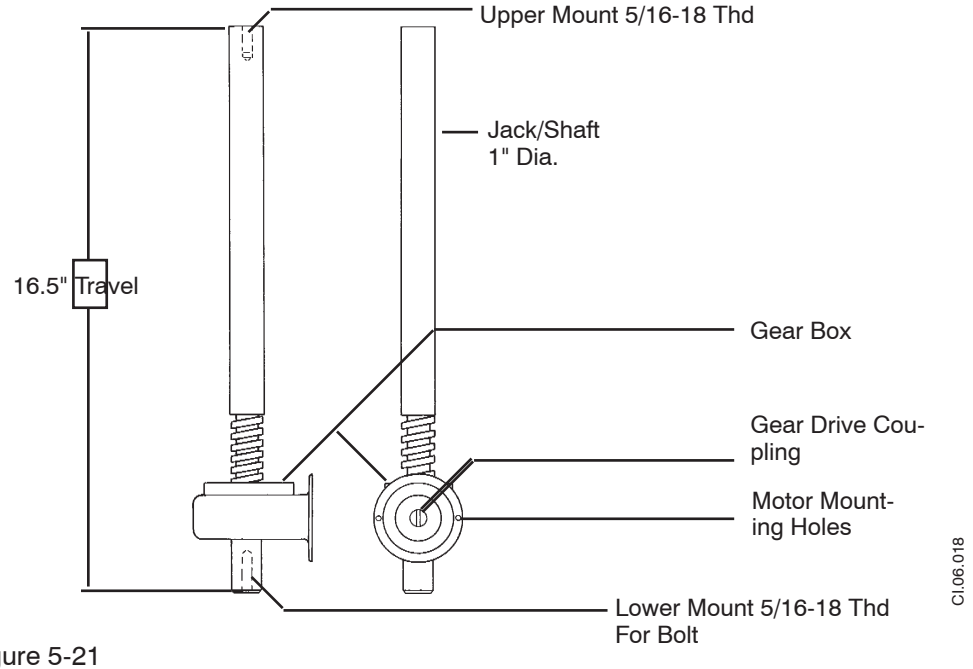


Figure 5-21
Gearbox and Jack-Shaft Assembly.

13. Remove the motor/jack-shaft assembly to replace the motor, motor coupling, phase capacitor, gear box and shaft, or power cable.

14. Re-assemble according to section 5.6 H

B. Motor Replacement

Disassembly

The motor is bidirectional. It has thermal overload protection and there are three (3) power connection wires:

White - Common, connects to the power cord
Red - Clockwise Rotation, connects to capacitor
Black - Counter-Clockwise Rotation, connects to capacitor

1. Use a 3/8 inch wrench to remove the two nuts that hold the motor housing to the gear box assembly. On Type 1 units, one of these nuts holds the ground connection from the motor housing power cable. On Type 2 units, remove the 8-32 hex nut from the base plate ground stud to disconnect the motor ground wire.

2. Lift the motor away from the gear box assembly. The motor shaft is coupled to the gear drive with a hard rubber coupling. Make note of how the coupling is oriented for reassembly—it is slotted for alignment with a gear drive coupling in the recess of the gear box.

Reassembly:

Note: When replacing the motor, you must align the groove in the motor coupling with the drive coupling in the gear box. Ensure that the slot of the motor coupling and the drive coupling are in approximately the same plane. The coupling will settle into final alignment when the jack-shaft is turned. The motor cable should be on the top left when the motor is reassembled to the gear box (as viewed from the rear of the motor).

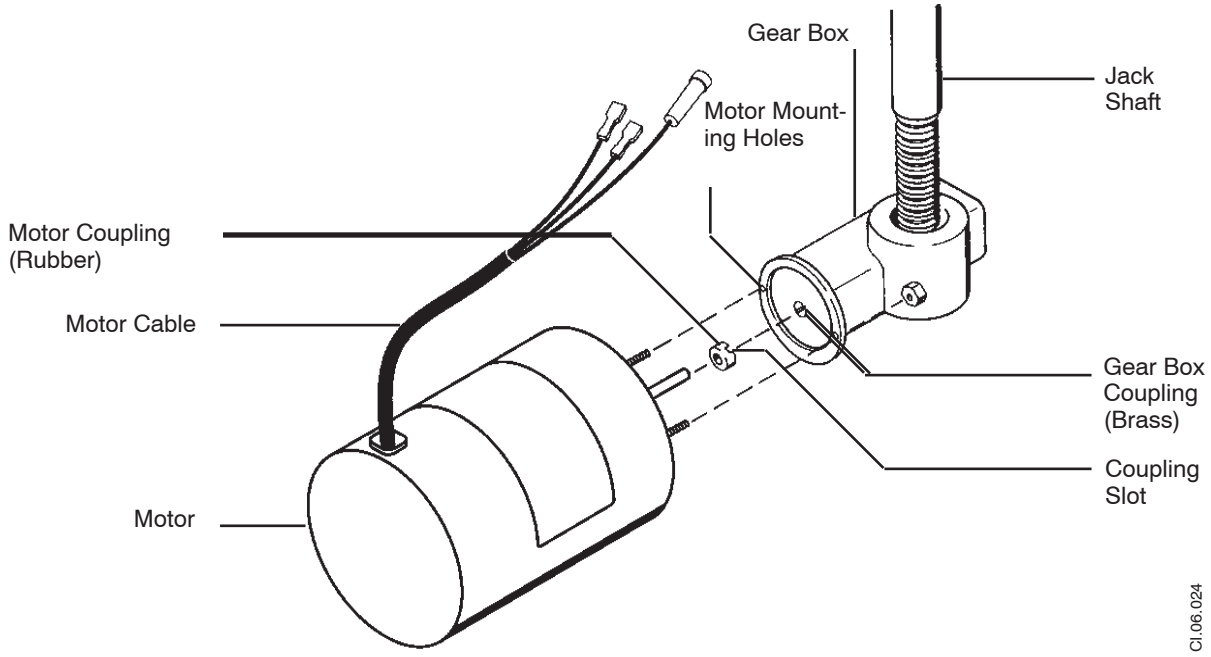


Figure 5-22
Motor and Gearbox Assembly.

1. Slip the motor coupling into the gear box assembly and align the studs of the motor housing with the mounting holes on the gear box.

2. Start the 10-32 nut on the right side (viewed from the shaft end of the motor). Do not tighten.

3. On Type 1 units, replace the ground wire for the motor housing and start the threads of the 10-32 hex nut. Fit the motor housing against the gear box to ensure proper alignment of the coupling.

4. If the motor does not easily fit flush against the gear box, check the coupling alignment.

5. When the motor is properly aligned, tighten the motor mounting nuts.

6. On Type 2 units, re-connect the motor ground lead to the base plate

C. Jack Replacement

The gear box/jack-shaft is a single assembly. The preceding procedures explain disassembly. See Figure 5-22 for gear box/jack-shaft configuration.

D. Capacitor Replacement

WARNING

⚠ When disassembling the elevating base, observe the following safety precaution to avoid electrical shock hazard from high voltage. Safely discharge the capacitor prior to removing any connectors.

1. Carefully discharge and then disconnect the capacitor as detailed in the General Disassembly procedure, steps 9, 10 and 11.

2. To remove and replace, disconnect the red and black wire connectors, lift out the old capacitor from the mounting base and slip in the new one. On some models (those with a capacitor with a plastic casing) it may be necessary to install a capacitor mounting bracket first to accommodate the larger size replacement capacitor (with a metal casing). See 7/Illustrated Parts.

3. Reconnect wires. Ensure that connections to the capacitor are power cord red and motor red to the same terminal, power cord black and motor black to the other terminal, see Figure 7-12.

   Note: Failure to observe the preceding step will result in the bed moving in reverse of the panel indicators.

E. Power Cord Replacement

In order to replace the power cord, the jack shaft assembly must be removed as described in 5.6A. The power cord is a special coiled, four-conductor, rubber covered cord. It has a four (4) pin Mate-N-Lok connector on the upper end and red, black, white and green wires on the other end. The white wire has a single pin connector which attaches to the white motor lead with a mating connector. The green (ground) wire is crimped into a ring-tongue lug which also has a short green wire (with a crimp on lug) to provide the motor ground connection.

1. Disconnect all electrical connections.

2. The upper end of the power cord is held in place by a strain relief bushing which must be compressed to remove.

3. The lower end of the power cord is held in place by a cable clamp which is attached to the assembly base plate. The clamp must be removed.

4. The power cord should be free for removal and replacement.

5. In some cases, it may be necessary to replace the strain relief bushing.

F. Column Guide Lubrication on Type 1 units

Anytime service is required on the lift, the column guides should be lubricated.

Note: The elevating base must be completely removed from the warmer and top mounting screw removed from the jack shaft before performing the following procedure.

1. The person positioned at the top of the unit must hold it while the second person at the bottom pulls the lower part of the unit away from the top. The distance between full lowered position and full raised position is eight (8) inches.

2. Use a cotton swab or your finger to apply Lubriplate (6600-0095-300) along each inside corner of the lower column. The column guides ride on this surface.

   Note: The unit moves eight inches from the fully lowered position to the fully raised position. If you pull it apart any further, the unit will separate, and then you must use the following procedure to rejoin the upper and lower columns.

   a. Remove the four (4) hex nuts that secure the lower end of tension springs with a 3/8 inch wrench. See Figure 5-20.

   b. Use long-nose pliers or a spring hook to remove the lower loop of the tension springs.

WARNING ⚠ Depending on the position of the upper column in relation to the lower column, the springs could be heavily or lightly tension loaded. Use care when releasing the springs.

c. Push the column guides toward the bottom of the column. The slotted mounting holes will position the guide so the top section of the column will slide in the bottom section.

d. Slide the two sections together ensuring that they are properly aligned. It may take several attempts to slip the lower column section over the top while clearing the guides. When the top column is properly positioned the hole for the screw jack is to the front of the column.

e. After the two units are rejoined, check that they slide without binding.

f. Replace each tension spring by reconnecting the end-loop to the stud on each guide.

g. Apply a small amount of #242 Loc-Tite to the stud threads and replace the four (4) hex nuts.

G. Column Guide Lubrication - Type 2 units

Note: If the inside of the column is painted, it requires no lubrication on bearings or column.

1. Raise the Elevating Base to highest position. If the the column is raised more than eight inches, the column sections will separate and the the upper and lower columns will need to be rejoined by following the procedure after step 6 below.

2. Remove the warmer from the base.

3. Apply lubriplate grease (6600-0095-300) to the sliding surfaces of the upper elevating column (located at inside four corners).

4. Lubricate the slide blocks (T-shaped molded nuts) and slots where the slide blocks ride.

5. The actuator screw should also be lubricated at this time. Apply lubriplate to the exposed threads of the screw.

6. It is not necessary to lubricate the 2 round disk glides located at the front bottom of the upper elevating column.

If the columns become separated

a. Spread each of the four spring tensioned bearing pairs apart and insert a 4.5 inch long spacer between the slide blocks on the inside of the lower column.

b. Slide the upper column down over the inner column.

c. Mate the 2 upper shock mount studs with the holes in the upper column flange and install the lockwashers and nuts.

d. Remove the spacers from between the bearing pairs. Use care, springs may release suddenly.

e. Re-assemble warmer to base.

H. Elevating Base Reassembly

1. To reassemble the elevating base, reverse the steps of 5.6A. When reinstalling the motor jack shaft assembly, make sure that both lock washers (inside and outside) are in position at the top of the jack shaft as shown in Figure 5-19. Refer to Figure 5-20 for the wire harness connector pin assignments. Make sure the pins are securely locked in the connector. The locking tangs on the pins sometimes remain retracted after removing them and must be bent back out to lock in place properly.

2. Perform the electrical safety and calibration procedures in section 4. Perform the checkout procedures detailed in section 2.2

I. Footswitch replacement, Type 2 units only

1. To remove the old footswitch, first peel the footswitch membrane from the warmer base, making note of how the membrane fits against the guide bar. Then pull the footswitch ribbon cable tail up through the slot in the base. To disconnect the left footswitch, peel off the two adhesive connector retainers, then unplug the two connectors from the footswitch connector, making note of their orientation.

   Important: Be sure to remove all the adhesive residue from the warmer base. Leaving old adhesive on the warmer base surface may cause the new footswitch to fail prematurely.

2. Connect the new footswitch to the two connectors in the same orientation as the old footswitch. Peel the backing off two of the adhesive retainers, and sandwich them around the connectors. Push the cable back down in the slot.

3. Peel the backing off the footswitch membrane and position it on the warmer base so that it lines up flush against the guide bar. Be careful not to let the ribbon cable tail stick to the membrane adhesive.

   Note: The right footswitch has only one connector that mates with the ribbon cable tail.

5.7 Caster Replacement (All Models)

Use the following procedures to replace the casters on all IWS models. Section A applies to all IWS models except the model 3500. Section B applies to the model 3500 Warmer. Section C applies to the Model 3500 Bassinet. Before starting to replace a caster, be sure you have the assistance of another person and the correct replacement parts. When replacement is completed, perform the indicated checkout procedures.

WARNING

⚠ Due to the size and weight of the warmer at least two people are required to replace a caster.

⚠ Before any disassembly or repair disconnect the power supply, gas pipeline supply connections, remove any gas cylinders and remove any accessories from the uprights.

⚠ When lowering or lifting the Infant Warmer System to and from the floor for inspection or repair, use two people for safety. Always ensure that you lay the unit on its right side (as viewed from the front) when laying the unit down. The heater/lamp housing does not lock and pivots to the left for access.

A. Caster Replacement (Except Model 3500)

(See Figure 7-8)

The casters on all models except the 3500 can be replaced with the warmer upright or carefully placed on its right side (facing the front.)

1. Disconnect the power cord.
2. Disconnect pipeline gas supplies.
3. Remove any gas cylinders and any accessory equipment.
4. Lock or block all remaining casters to keep the unit from rolling around (unless the unit has been laid on its side).
5. Use blocks to support the frame near the caster you are replacing.
6. Remove the plastic end plate from the stand assembly.
7. Use a 7/8" socket and ratchet to remove the caster mounting nut.

   Note: There is another nut underneath the caster. You may have to hold this nut while removing or tightening the caster mounting nut.
8. Tilt the unit (unless the unit has been laid on it's side); remove the old caster and install the new caster .
9. Replace the mounting nut and tighten securely.
10. Replace the plastic end cap.
11. Perform the checkout procedure, section 2.2, and, if the unit was laid on its side, the electrical safety checks, Section 4.

B. Model 3500 Warmer Caster Replacement

(See Figure 7-13)

1. Disconnect the bassinet from the warmer and move it out of the way.
2. Disconnect the power cord.
3. Disconnect pipeline gas supplies.
4 Remove any gas cylinders and all accessory equipment.
6. With the assistance of another person, gently place the model 3500 on its right side (facing the front) on the floor.
7. Make note of the orientation of the caster you are replacing. Using a Phillips screwdriver, remove the four caster mounting bolts and the lock washers.
8 Remove the old caster and install the new one, orienting it like the old one. Be sure to include a lock washer under each mounting bolt.
9. With assistance of another person, place the warmer in its upright position.
10. Perform the checkout procedure, section 2.2, and the electrical safety checks, Section 4.

C. Model 3500 Bassinet Caster Replacement

(See Figure 7-24)

1. Disconnect the bassinet from the warmer and move it away.
2. Remove the drawers (refer to section 5.5) and note their positions for re-assembly.
3. With the assistance of another person, gently place the Bassinet on its side on the floor.
4. Make note of the orientation of the caster you are replacing. Using a 3/16" Allen wrench, remove the four mounting bolts and the lock washers.

5. Remove the old caster and install the new one, orienting it like the old one. Be sure to include a lock washer under each mounting bolt.

6. With the assistance of another person, place the bassinet in the upright position

7. Re-install drawers.

8. Perform the checkout procedure in section 2.2.

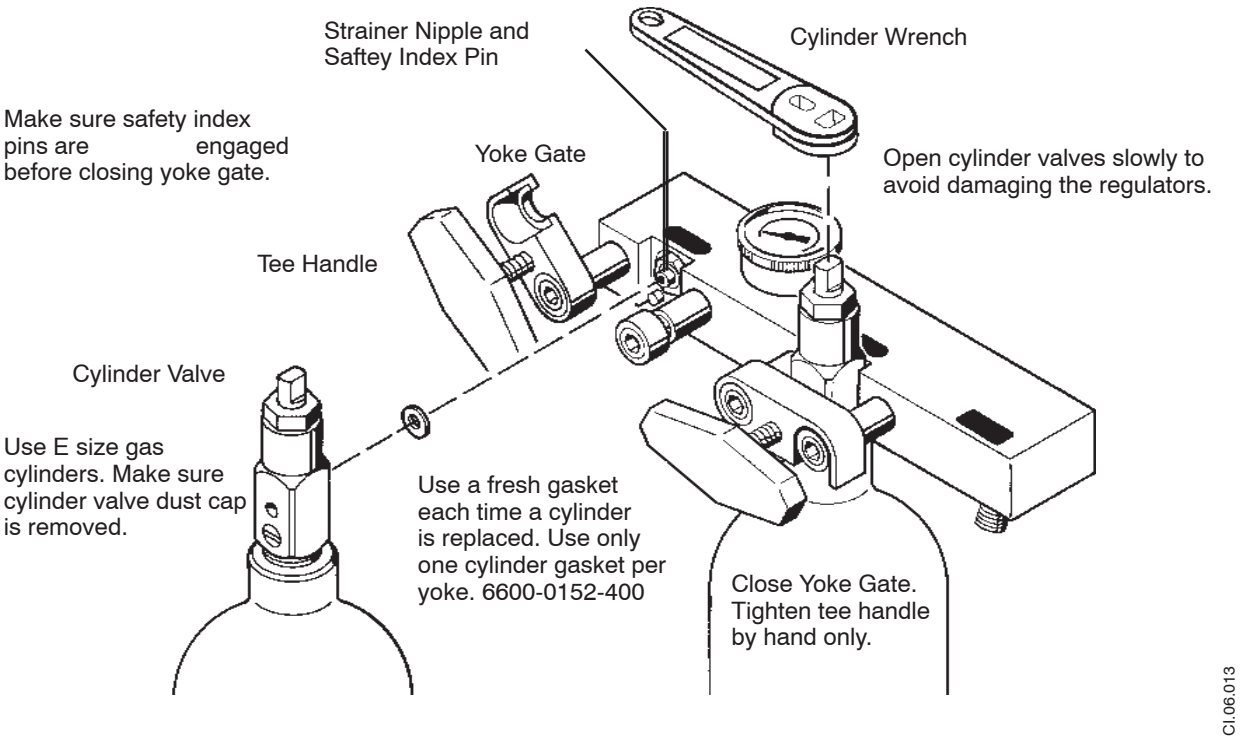


Figure 5-23
Oxygen Manifold Maintenance

Vac Kote is a trademark of Ball Corporation.

5.8 Oxygen/Air Yoke Manifold Repairs

WARNINGS

⚠ Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. Vac Kote is (6700-0092-200) or Sentinel OPG (6700-0067-002) are the oxygen service lubricants recommended.

⚠ Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

⚠ Only competent individuals trained in the repair of high pressure gas equipment should attempt to service it. Unqualified repairs may result in serious injury or equipment damage.

A. General Safety Guidelines

1. Work in a clean area with clean tools and keep parts on a clean surface.
2. Do not allow dirt, oil, grease, or other combustibles to come in contact with the regulator or other parts.
3. Use only nitrogen or dry, compressed air to blow a part clean or dry. Never use compressed air containing oil: it can create a fire hazard.
4. Always use the correct socket, box or open end wrenches. Never use a pliers, pipe wrench, or adjustable wrench.
5. If you have even the slightest doubt about the condition of a part, replace the part.

WARNING

⚠ When servicing an oxygen manifold, use only new Ohmeda parts as shown in this manual. Because of the high pressure gas application, it is essential that you never substitute parts from another manufacturer or use parts that are not clean for oxygen service.

B. General Maintenance Procedures

Before any yoke manifold repairs:

1. Disconnect the warmer from the AC power source.
2. Disconnect pipeline gas supplies.
3. Remove any gas cylinders. (See Figures 5-23 and 5-24)

These procedures apply to both the two cylinder oxygen manifold and the three cylinder air/oxygen manifold.

Periodically (at least once a year) lubricate the Tee handle threads with a small amount of oxygen service lubricant (Stock No. 6700-0092-200 or 6700-0067-002). This will prolong their life and make sealing of the yoke gaskets easier.

Periodically (at least once a year) inspect the yoke check valve strainer nipples and replace as required. Momentarily open and then close the cylinder valve before installing cylinders to blow any foreign material from the valve. When installing fresh cylinders, remove the old gasket and use a single, clean, new gasket in its place.

CAUTION

⚠ Use only one cylinder gasket per yoke. Using more than one gasket could cause a cylinder gas leak.

Note: If the oxygen pipeline inlet check valve leaks, the problem may be caused by the steel ball (stock no. 0409-1697-000) getting caught in the spring (see Figure 5-25). To correct this problem remove the elbow and spring. Discard the spring and replace it with screen (Stock no. 6600-0461-400). Reassemble the valve ensuring the ball and O-rings are in place as shown in the figure.

C. Use of Pipeline Air and Oxygen Supplies

1. Connect pipeline supply(s) to appropriate pipeline inlet(s).
2. Connect desired equipment to the appropriate outlet(s).
3. Ensure correct operation of the secondary pipeline equipment.

Apply Teflon® tape around all pipe threads. Wrap the tape clockwise, starting one thread up, as viewed from the end of the male fitting. Apply enough pressure so the tape just starts to follow the contours of the threads. Wrap two layers of tape.

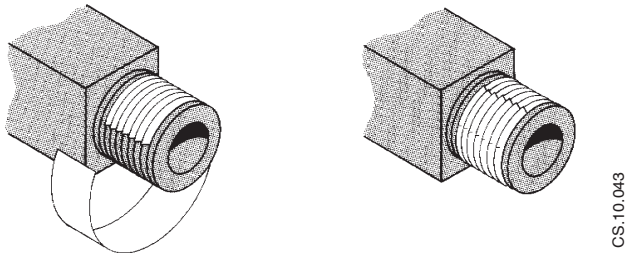


Figure 5-24
Applying Teflon Tape.

To operate, open cylinder valves S-L-O-W-L-Y, and rotate cylinder valves until fully open.

CAUTION ⚠ Open cylinder valves S-L-O-W-L-Y to avoid damaging the regulators.

D. Gauge Replacement

WARNING ⚠ When replacing gauges, verify that pressure range of the replacement gauge is the same as the one you are replacing, and that the correct gas is shown.

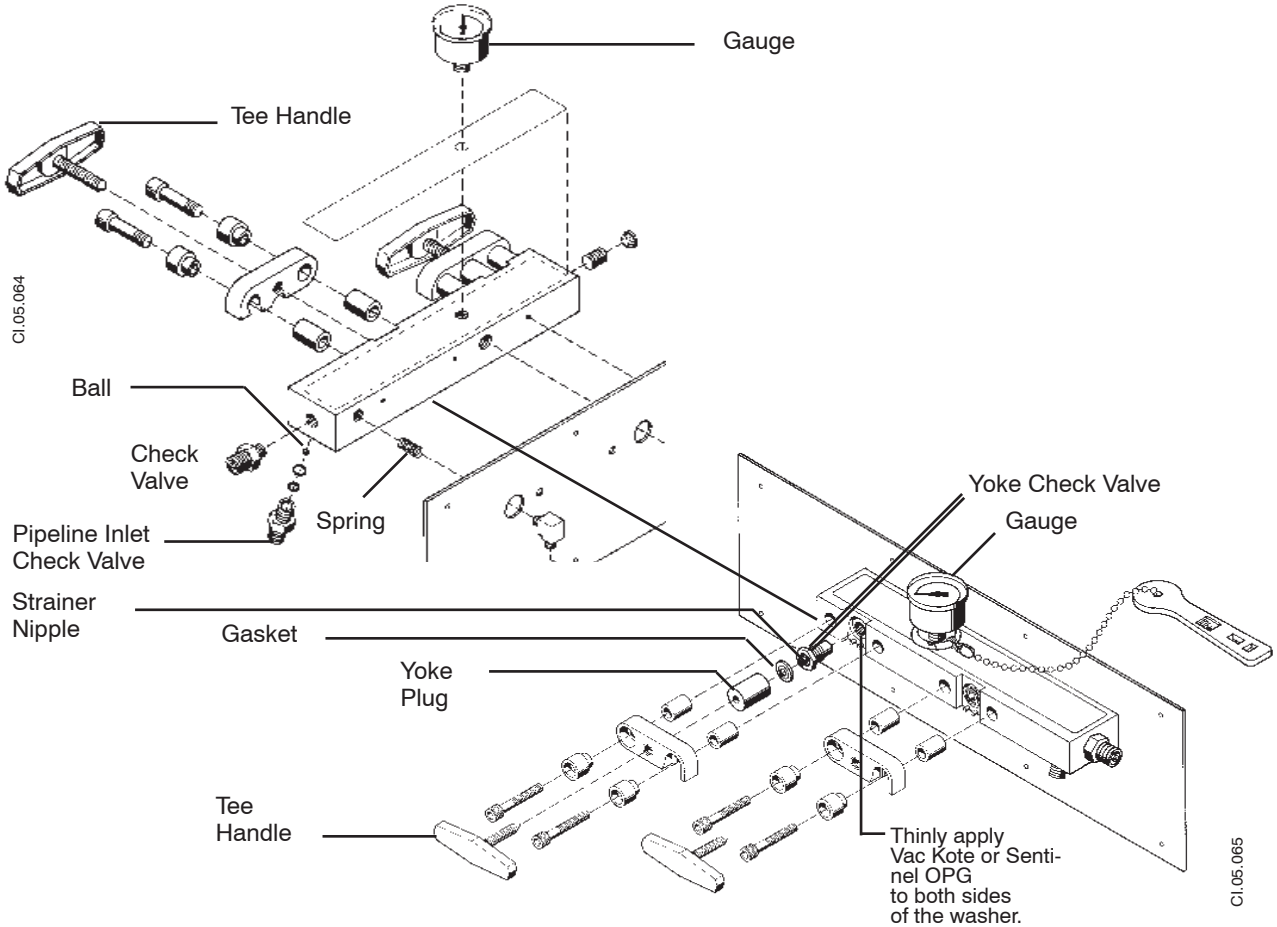


Figure 5-25
O_2 Manifold Assembly (Air/O_2 Manifold Assembly not shown)

1. Turn off gas supply and bleed off any system pressure.

2. Use a 7/16 inch open end wrench and turn the gauge counterclockwise to remove it.

3. Remove any Teflon tape remnants from the threads.

4. Apply Teflon tape around the threads of the new gauge .

5. Install the new gauge by turning it in clockwise. Do not over-tighten. Position the gauge as shown in Figure 5-25.

6. Perform leak test according to section 5.8 G.

E. Gauge Lens Replacement

1. Turn the lens cover counterclockwise to remove it. Check that the gauge is not damaged.

2. Clean both sides of the replacement lens.

3. Place the lens cover in position over the gauge face and turn the lens clockwise. Do not over-tighten.

F. Strainer/Tee Handle Replacement

Periodically (at least once a year) inspect the strainer nipples and replace as required. The strainers are located in the cylinder yokes of the gas supply modules. Remove the gas cylinder, if present. With the yoke gate swung out of the way, use a flat-tip screwdriver to unscrew the strainer. Screw the replacement strainer snugly into place. Install yoke plugs and gaskets on unused yokes to prevent dust and lint from accumulating in the strainers or leakage occurring through unused cylinder yokes. Check that the correct gas cylinders can be properly attached to the yokes.

The tee handle screw can be unscrewed from the yoke gate and replaced if necessary.

G. Leak Testing the System

Prior to initial use and as prescribed by hospital protocol, the yoke system(s) should be checked for leaks according to the following procedure:

l. Discontinue use of the system to be tested.

2. Disconnect all pipeline gas supply and outlet lines from the yoke assembly.

3. Use new gaskets and full cylinders at each cylinder port (optionally, one full cylinder and a yoke plug may be used on a 2 cylinder oxygen manifold)

4. Open a cylinder valve at each manifold to charge the manifold(s) to a minimum of 745 psig (5137 kPa) and then close the valve(s).

5. Note the gauge pressure reading in the manifold(s).

6. After one minute, check the gauge pressure reading(s) again. The pressure gauge needle should not drop visually. If there is a visual pressure drop, discontinue use of the gas system and have the yoke assembly repaired by a qualified service person.

H. Yoke Check Valve Replacement

The yoke check valve permits a depleted cylinder to be replaced while the other cylinder continues to furnish oxygen.

WARNING: ⚠ Do not use oil or oil bearing materials on or near the regulator. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. The air or oxygen regulators or any regulator parts must be discarded if contaminated with oil or grease.

CAUTION: ⚠ Yoke check valves are not intended to provide a leak free seal; always use a yoke plug and a fresh cylinder gasket to seal an unused yoke.

Replace the check valve if a large leak is detected when changing the cylinders.

1. Remove the gas cylinder(s), if present and bleed off any system pressure. With the yoke gate swung out of the way, use special socket tool (stock no. 0175-0420-000) to remove the check valve from the manifold block.

2. Always install a new sealing washer (6700-0032-3) when installing a yoke check valve. Thinly lubricate both sides of the sealing washer with Vac Kote (6700-0092-002) or Sentinel OPG (6700-0067-002).

3. Tighten the check valve to 15 - 20 lb. ft. torque. Do not over tighten.

4. Check that the correct gas cylinders can be properly attached to the yokes. Perform leak test according to section 5.8G.

I. High Pressure Regulator Replacement and Adjustment

(See Figure 5-26 and 5-27)

Replace regulators every 5 years

WARNING: ⚠ Do not use oil or oil bearing materials on or near the regulator. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. The air or oxygen regulators or any regulator parts must be discarded if contaminated with oil or grease.

1. Disconnect the gas pipeline connection(s) and remove the gas cylinder(s). Bleed off any system pressure.

2. Remove the mounting screws for the Yoke and Regulator Assembly and then remove the assembly.

3. Disconnect the copper tubing from the outlet port of the regulator and the elbow of the manifold port. Remove the outlet port fittings and copper tubing.

4. Remove the regulator from the manifold block by turning it counterclockwise.

Remove any Teflon tape remnants from the threads.

5. Attach the new regulator to the manifold block. Use Teflon tape to seal the thread connections. Tighten to ensure there are no leaks. Position the regulator the same way as the original regulator. See Figure 5-27. Replace the outlet port fittings and copper tubing.

6. Perform leak test according to section 5.8 G.

7. Adjust the regulator following the instructions in section 4.4.

8. Place the assembly in position and replace the eight mounting screws.

9. Perform leak test according to section 5.8 G.

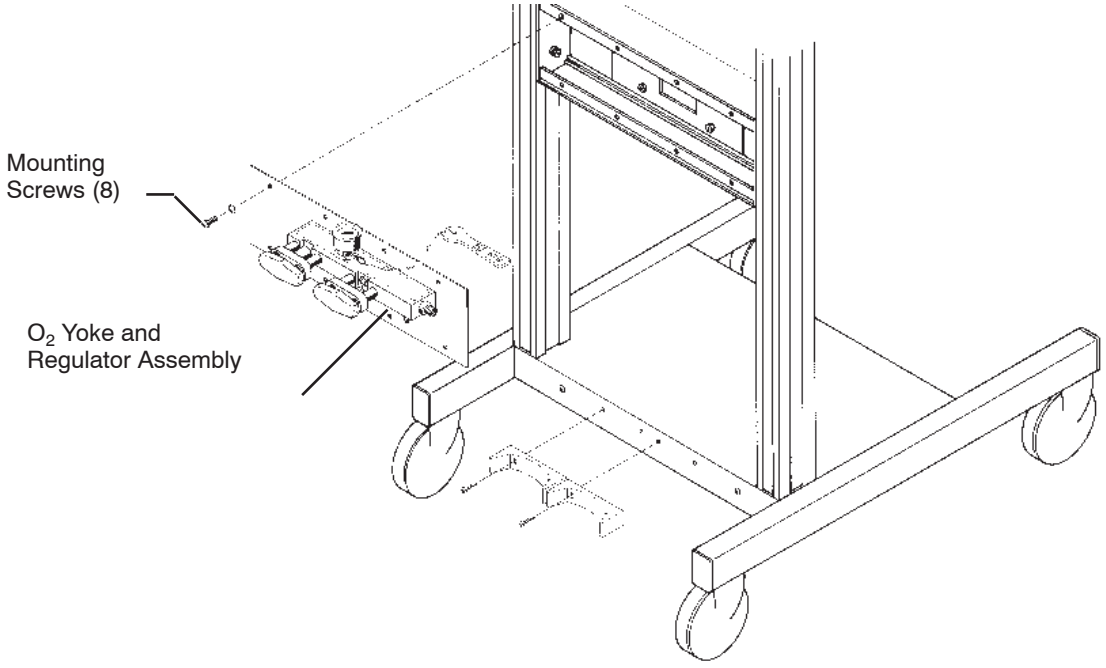


Figure 5-26
Manifold Assembly Removal

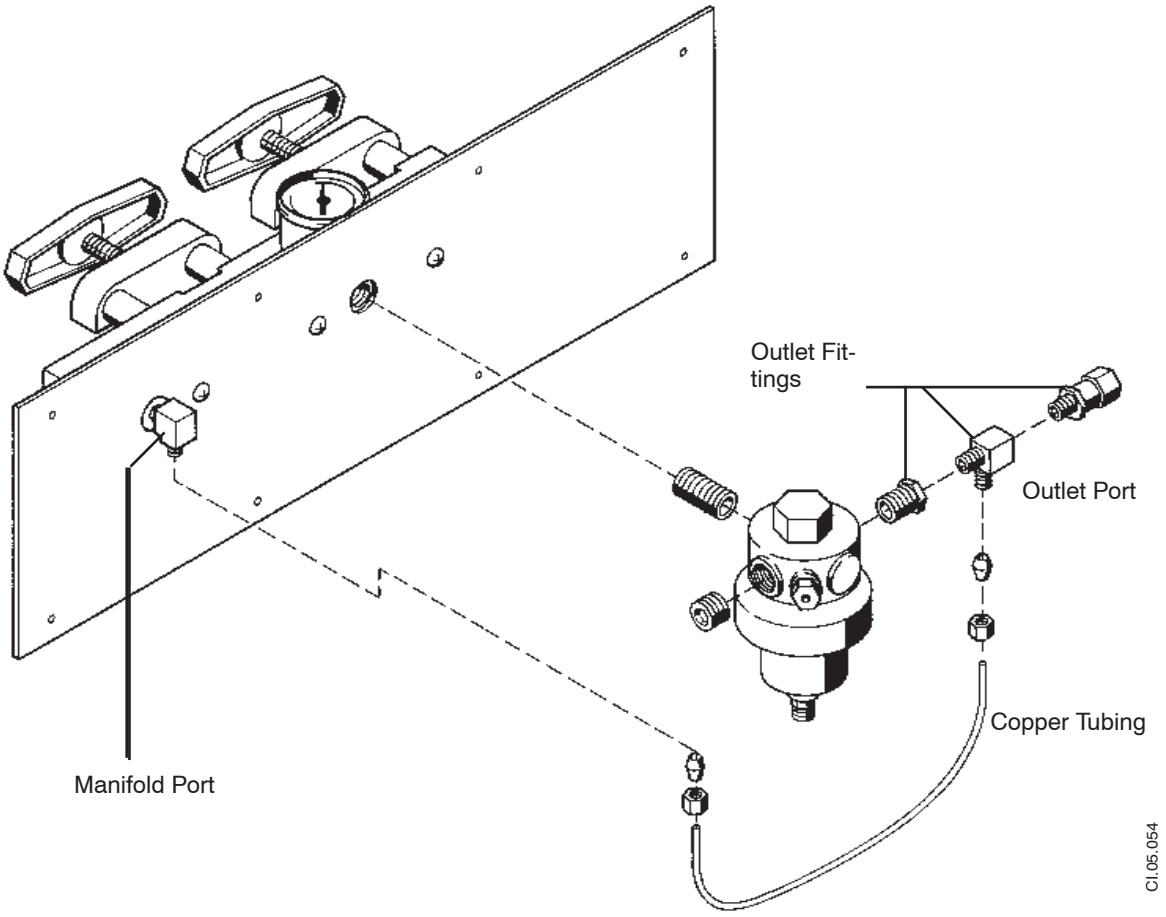


Figure 5-27
High Pressure Regulator

I. Pneumatic Troubleshooting

This troubleshooting information provides a list of some problem conditions, possible causes, and solutions. If any of the below symptoms occur, shut off the cylinder valve and correct the problem before continuing to use the system.

Condition	Possible Cause	Solution
Gas leakage when cylinder valve is opened.	Dirty, old, missing or multiple cylinder gaskets.	Install new gasket.
	Leaking pipeline inlet or supply check valves.	Check operation of check valves.
		Check that the ball is not stuck up inside the manifold or spring. Replace the spring with a screen (see parts section 7).
Gauge reading drops with cylinder valve closed.	Missing yoke plug on unused yoke.	Install new yoke plugs.
	Leaking check valves, fittings, regulators or gauges.	Replace components.
Improper gauge operation incorrect gauge readings.	Damaged gauge.	Replace gauge.
Gas leakage at the regulator outlet when the adjustment screw is completely released.	Leaking regulator.	Replace regulator.
Outlet pressure increases steadily above set pressure (no flow through system).	Leaking regulator.	Replace regulator.
Gas leakage from regulator case.	Leaking regulator.	Replace regulator.
Excessive drop in working pressure after the regulator pressure has been set.	Worn or sticking in-internal parts. Internal flow obstructed, or dirty filter. Cylinder valve not fully open. Dirty yoke check valve strainer nipple.	Replace regulator. Check for flow obstructions. Fully open cylinder valve. Replace strainer nipple.
Gas leakage from regulator or safety relief valve.	Leaking regulator or safety relief valve.	Replace regulator or safety relief valve.
Incorrect working pressure.	Regulator requires pressure adjustment.	Adjust pressure.

5.9 Armoire Service Procedures

Fan Filter Replacement

1. Disconnect power to the unit.
2. Remove the 4 Phillips head screws that retain the shroud and remove the shroud.
3. Disconnect the fan power cord.
4. Unsnap the filter retainer from the bottom of the fan.
5. Inspect filter. Replace if necessary

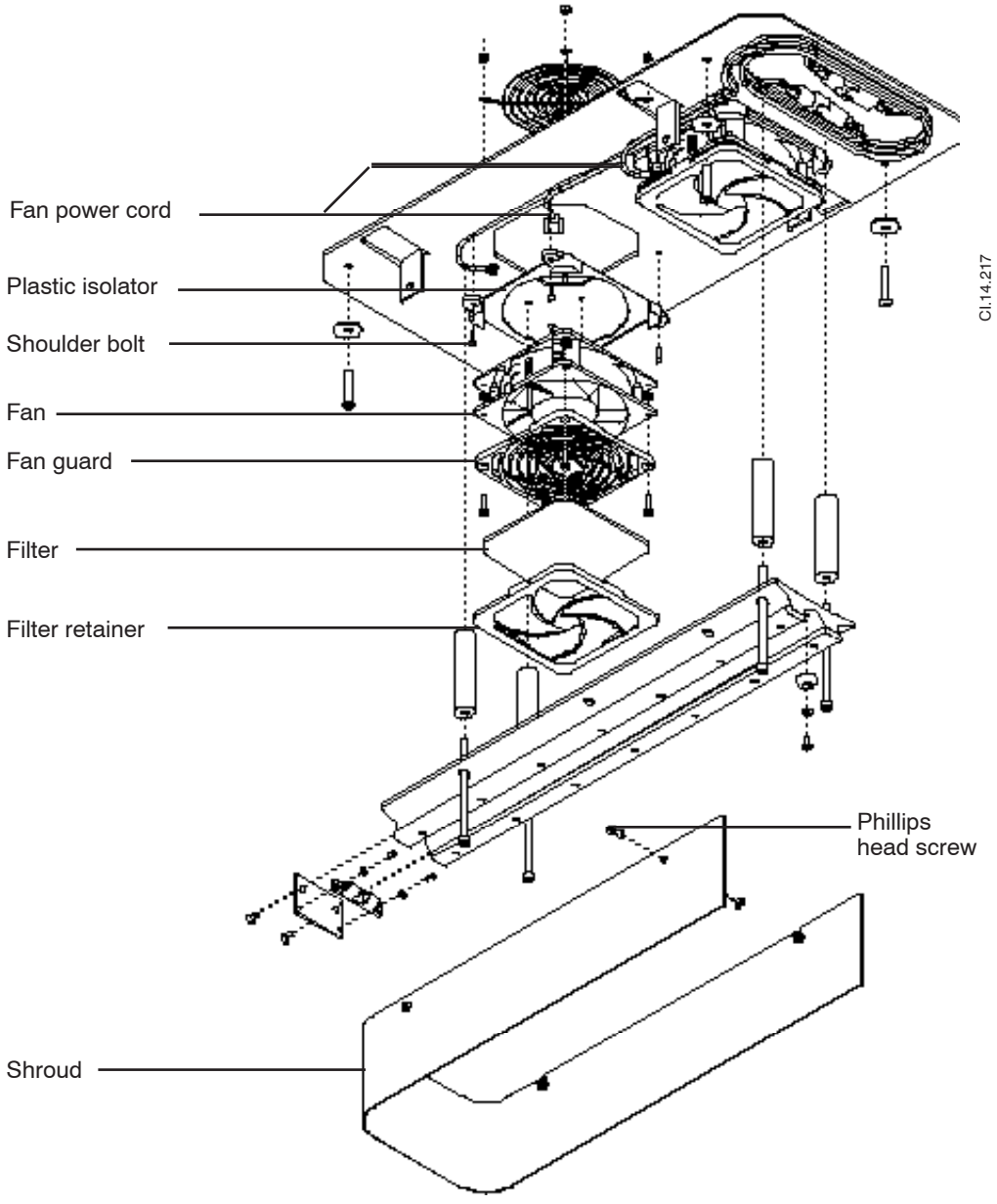


Figure 5-28
Exhaust fans

Fan Replacement

1. Disconnect power to the unit.
2. Remove the 4 Phillips head screws that retain the shroud and remove the shroud.
3. Disconnect the fan power cord.
4. Remove the phillips head screw that secures the ground wire and remove the ground wire.
5. Using a 2mm hex key, remove the four shoulder bolts, one at each corner of fan, that secure the plastic isolator. Bend down one of the isolatorís corners and remove the fan from the plastic isolator.
6. To remove the filter assembly from the fan, unsnap the filter retainer and remove it and the filter to expose the fan guard screws. Then remove the 4 screws and nuts that secure the fan guard with a 2.5mm hex key and a 7mm open end wrench.

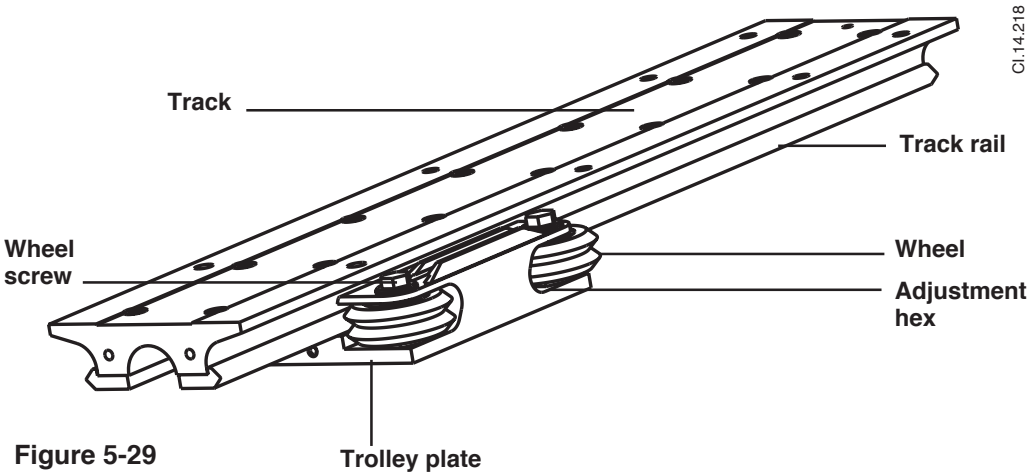


Figure 5-29
Trolley and track

Mounting Track Lubrication

The mounting track rails (the surface the trolley wheels ride on) should be periodically lubricated to prevent corrosion. Disconnect power and remove the shroud. Coat the entire track rail with a lubricant, such as petroleum jelly or Lubriplate®.

Trolley Wheel Adjustment

Note: Adjustment of the wheels may require the warmer and the warmer rail assembly to be removed from the cabinet. Trolley wheel adjustment is not required as part of periodic maintenance.

Trolley wheel adjustment requires a 3/4" and a 7/16" thin open end wrench (service part number 6600-0880-200). One side of the trolley will have a pair of adjustable eccentric bearings. The adjustable pair has hexes between the wheel and the trolley plate that can be gripped with the larger thin open end wrench. Turn the hex between the wheel and the plate to adjust the lateral distance between the wheel and the edge of the track rail. This gap should be less than 0.010 inch.

One way to check proper adjustment is to slide the trolley along the track while preventing the wheels from turning with your fingers. Tighten until you can not hold the wheels from rolling, then back off on the adjustment to the point that finger force holds the wheels from rolling while sliding the trolley.

If the bearing hex can not be moved remove the warmer. The wheel screw may be loosened and retightened after the bearing adjustment. If the wheel screw is loosened, remove the screws for the adjustable bearing and apply Loctite 242 to the screw threads prior to adjusting the bearing hex.

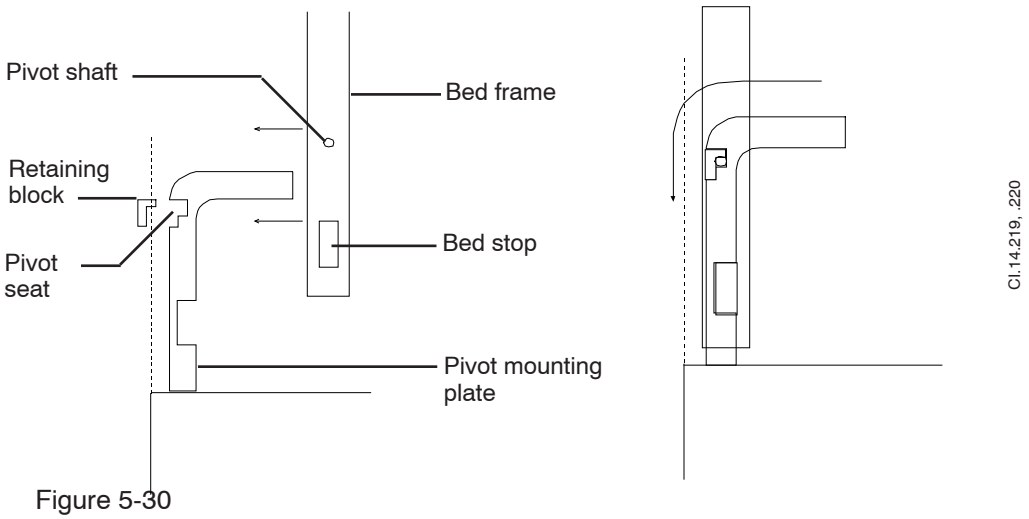


Figure 5-30

fold down bed installation

Bed Installation

1. Remove and retain the 2 pivot shaft retaining blocks by using a 5/32" hex key to remove the screws that secure them.

2. Install the bed assembly by tilting the head of the bed down so that the bed stops slide under, and the pivot shafts slide over, the pivot mounting plates. Pull the bed forward in the vertical position, so the pivot shafts slide over the curve in the pivot plate, slide the shafts into the pivot seat recesses. Turn the shafts so the flats on the shafts rest in the recessed surface when the bed is in the vertical position.

   Important: The pivot shafts must be installed in the pivot seats with the bed assembly in the vertical position or the shaft springs will be incorrectly loaded.

3. Push the bed back so the pivot shafts go all the way into the pivot seats. Make sure the bed is centered between the two mounting plates. Secure the 2 retaining blocks with the 4 socket head cap screws. Torque to approximately 50 in-lbs.

WARNING

⚠ Screws must be installed in the retaining blocks. Failure to do so may cause the bed to fall out of the cabinet.

4. Install the two wood veneer strips on the bed pivot mounting plates. Align the strip with the bottom of the pivot mounting plate then match the holes on the one strip with the bed latches on the right of the bed. Peel off the adhesive backing and apply the strips working from the bottom of the mounting plates up and over the curves.

5. Reinstall the patient bed to the bed frame by placing it back into its hinges and releasing the spring loaded pins. Reattach the safety lanyard.

6. Install the four bed side panels. Push in the pins on either side of the panel, then slide the bottom pins in the bed side ends into the slots in the corner blocks, then rotate the sides up until they lock in position.

7. The mattress will fall away from the bed in the upright storage position. If desired, secure the mattress to the bed with the Velcro tape provided.

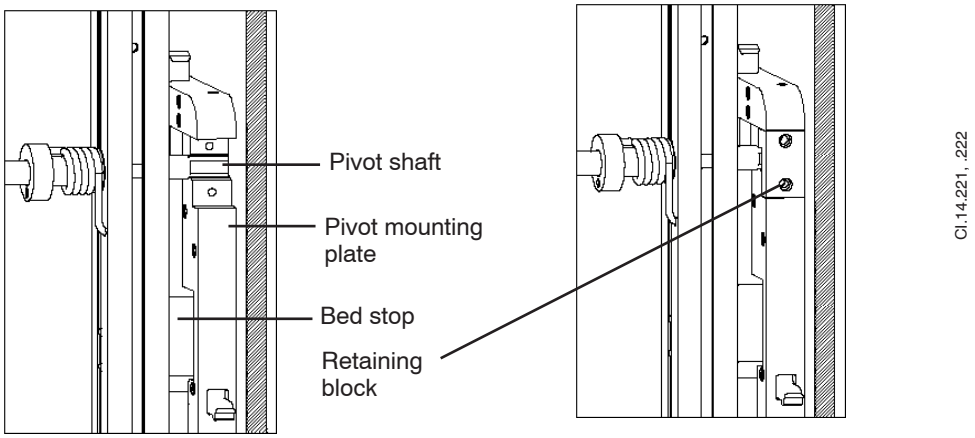


Figure 5-31
Seating pivot rods and securing the bed

Bed Frame assembly

Remove the bed from the cabinet. See Figure 5-30.

1. To reassemble bed frame, first place parts on a flat surface.

2. Slide the top of the T-bolt into the channel in top/bottom frame extrusion.

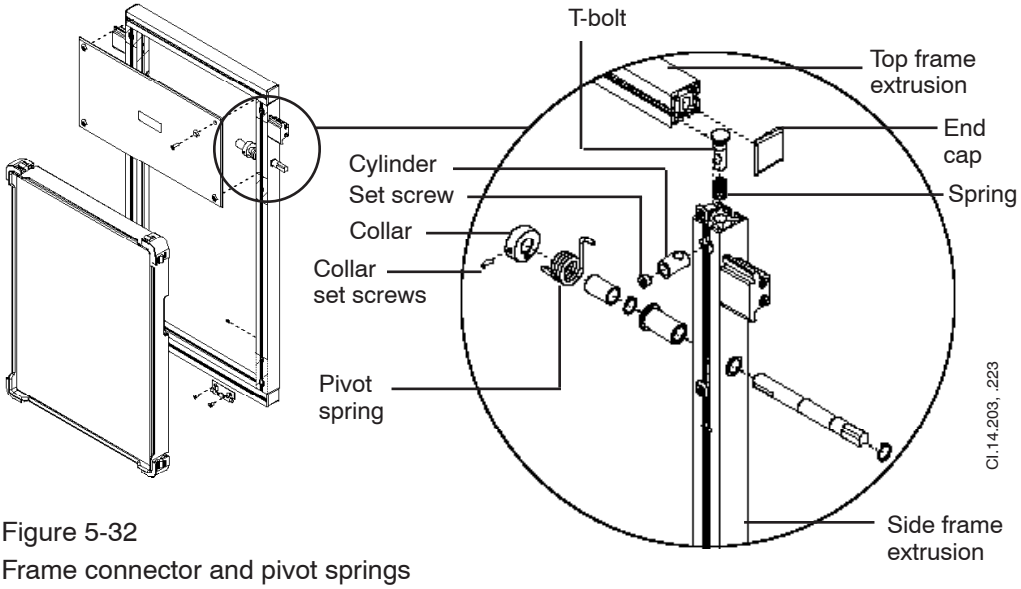


Figure 5-32
Frame connector and pivot springs

3. Insert endcap into the end of the top/bottom frame extrusion.

4. Push the cylinder into side frame extrusion. Align the hole in the cylinder with the center hole in the extrusion.

5. Align the seat on the T-bolt so it aligns with the set screw, place the spring over the T-bolt, then push the bolt into hole in the end of the side extrusion.

6. Secure the frame extrusions together by tightening the setscrew in the cylinder with a 6mm hex key. Make sure the two extrusions are square and that the surface of the endcap aligns with the outside surface of the side rail. Use Loctite 242 on the setscrew threads. Tighten to a torque of 28 $\pm$ 3 lb/ft.

Replacing the bed pivot springs

Remove the bed from the cabinet. See Figure 5-30.

1. Install the new spring. The long leg with the short end goes in the hole in the side frame extrusion; the other end goes into the hole in the collar. Do not compress the spring. The collar should not be up against the bend in the spring, but the spring should not be so loose that it comes out of the hole in the frame extrusion.

2. Use a 5/64" hex key to tighten the setscrew in the collar. Use Loctite 242 on the setscrew threads. Tighten to a torque of 15 $\pm$ 2 lb/in. Slide the spring between the collar and the frame; the spring legs should remain in the holes.

Power Switch Replacement

1. Disconnect power to the unit.

2. Remove the screws that hold the switch cover and remove the switch cover.

3. Disconnect the old switch, making note of the correct orientation of the 6 wire connection. Remove the old switch.

4. Install the switch, making sure the side of the toggle that has the light is on top.

5. Replace the switch cover and secure it with the screws removed earlier.

Fan Fuse Replacement

The fan fuses are located on the wire harness that runs down from the fans to the junction box and power switch.

1. Remove the four screws that hold the cabinet back panel on which the power switch is located, and remove the panel to access the fuses.

2. To open the two fuse holders (one for each fan) push the two ends together while twisting. The fuses are 1 amp fast blow.

Notes

WARNING ⚠ Use extreme care while performing calibration and adjustment procedures, or while working on the Ohio Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all standard safety precautions.

CAUTION Use the Static Control Work Station to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Note: Self test programs stop when a system error code is detected. Therefore a second error code will not be displayed for another failure. The same failure can trigger more than one error code. The actual code that appears is determined by the point in the test loop where the fault occurs.

Note: SW1 on the ThermaLink board (if present) should be in the OFF position.

For maximum reliability and ease of troubleshooting, the IWS features three levels of testing; Power-Up Self tests, On Line Self tests, and On Demand Self tests.

Power up tests are performed only on power up. On line tests are performed continuously during operation to verify proper functioning. Control panel switches activate on demand tests that can be used to assess error codes.

To facilitate service of older IWS units manufactured prior to software revision 4.01, a separate section on self test functions has been included in this section. Section 6.1 describes the self test functions for units with software revision 4.01 or higher. Section 6.2 describes the self test functions for all units prior to software revision 4.01.

6.1 Self Test Functions

(units with Software Revision 4.01 or higher)

6.1.1 Power Up Testing

When power is first applied, the following self tests are performed. If a failure is detected, the error code appears in the elapsed time display. If no error is detected, the tests are transparent to the user.

RAM test (Error 05)
Instruction test (Error 01)
Checksum (Error 04)
Safety relay (Error 16)*

* This is the only routine that checks for this error.

6.1.2 On Line Testing

The following self tests are performed continuously during normal operation. If a failure is detected, the error code appears in the elapsed time display.

RAM test (Error 05)
Checksum (Error 04)
ADC calibration (Errors 02 and 03)
Triac or solid state relay fails to respond to software control (Errors 12 and 13)
ADC not converting (Error 07)
Audible alarm failure (Error 14)
Software upsets (Errors 15, 17, and 19)
Line voltage out of range (Error 10)*

* This is the only routine that checks for this error.

6.1.3 On Demand Testing

There are two types of on demand testing. Calibration routines that let you test and adjust specific circuits and switch activated displays that display actual readings to assist in troubleshooting (e.g. the number of software time outs).

A. Calibration Routines

Calibration routines let you adjust specific circuits by depressing a switch during power up. You must switch the power off to exit these routines.

Test	Description	Applications	External Selection
ADC Calibration	Elapsed time display shows patient temp to two decimal places even if outside normal display range. 2KHz alarm active	Display Brightness adj. ADC calibration Alarm freq. adj.	Depress Start/Hold switch at power up
% Line Voltage	% of rated line voltage appears in elapsed time display. 2KHz alarm active	% line voltage calibration	Depress Reset switch at power up

The control and patient temperature displays tell you if you are in a calibration mode and identify the routine:

- In the ADC Calibration routine, the letters “CAL” appear in the patient temperature display and the letters “AdC” appear in the control temperature display.
- In the% Line Voltage Calibration routine, the letters “CAL” appear in the patient temperature display and the letters “LI.” appear in the control temperature display.

Note: On IWS 2001 International units, “CAL” appears in the patient temperature display regardless of which calibration routine is selected. If the value in the elapsed time display changes when you unplug, warm, or cool the patient probe, you are in the ADC calibration routine.

B. Switch Activated Displays

Switch activated displays show parameters, such as the % line voltage, on the controller front panel for easier troubleshooting.

In normal operation the Alarm Silence, the Start/Hold, and the Apgar Tones switches activate service displays when held down for more than five seconds. The high priority alarm also sounds to indicate that actual patient temperatures are not displayed. The normal display reappears when you release the switch.

The following table summarizes the data that will be displayed when each switch is depressed and held for at least five seconds. It is intended as a quick reference. Switch applications for troubleshooting are discussed in Section 6.3 under the individual error codes.

Activation	Description	Related Errors
Depress Alarm Silence for 5 sec	All LEDs and Display segments illuminate	None
	Phased in high priority alarm (alternating two tone) sounds.	None
Depress Start/Hold for 5 sec	Displays show converted values of:	
	Patient temp: Cal high temp to 1 decimal pl (25.05 ± 0.3°C)	Error 03
	Control temp*: Cal high temp to 1 decimal pl (37.96 ± 0.3°C)	Error 02
	Elapsed time: % line voltage to 1 decimal pl (% nominal ± 2%)	Error 10
Depress Apgar Tones for 5 sec	Displays show converted values of:	
	Patient temp: Pxx (xx = number of watchdog circuit time outs)	Error 19
	Control temp*: Hyy (yy = number of heater cycles per sec)	
	Elapsed time: Patient temperature (2 decimal places)	

* IWS 2001 International units do not have a control temperature display.

C. Self Test Loop

1. Self Tests

To enter this loop depress and hold the Apgar tone switch while powering up the unit. The microcontroller cycles through a series of self tests, including:

All of the power up tests

Instruction Test (E01)
EPROM Checksum Test (E04)
RAM Test (E05)

The following on line self tests

ADC High Calibration Failure (E02)
ADC Low Calibration Failure (E03)
ADC Failure (E07)
Heater Not Switching On (E12)
Heater Not Switching Off (E13)
Alarm Oscillator Failure (E14)
ThermaLink Self Test*

Important : Unless you specifically want to repeat the power up tests, troubleshooting should be performed in the normal operational modes.

2. Displays

The display loop runs simultaneously with the self tests, displaying frames of data and testing for proper LED operation. An alternating two tone alarm sounds continuously during the test. Frames are cycled as follows:

Temperature Displays

Frame	Patient Temp.	Control Temp.	Elapsed Time.
1.	——— All displays blank———		
2.*	rs	232	PASS /FAIL
3.	Patient Temp.†	Blank	00:00
4.	Low Cal. Point	High Cal. Point	%Nom. Voltage x .1
5.	— all segments of all displays are lit —		

*Only on controllers with 4.00 software or higher. Units without RS232 option installed will display rs232 FAIL.

† Only when the probe is connected, otherwise display is blank.

D. ThermaLink Communication Option Self Test

The RS-232 portion of the ThermaLink communications option, available only on controllers with 05.00 software or higher, can be tested by setting switch SW1 (if present) on the optional ThermaLink board to the ON position, or by shorting pins 2 and 3 on the ThermaLink Connector. Disconnect cable to other equipment before testing. Press the Apgar tones switch while powering up the unit. Release the switch when a continuous alarm sounds. If the RS-232 is functioning, the displays will cycle to a frame that shows:

Patient Temp	Control Temp	Elapsed Time
rs	232	PASS

On units with boards with no test switch, the first pass through may indicate “rs 232 FAIL” due to the varying warm-up times of the ThermaLink board and the control board. Do not shut the unit off; continue to run the test. If the ThermaLink board is functioning correctly, the display should show “rs 232 PASS” in all subsequent cycles.

Conversely, if the RS-232 is not functioning or is not installed, the temperature displays will cycle to a frame that shows:

Patient Temp	Control Temp	Elapsed Time
rs	232	FAIL

At the end of this test, be sure to set SW1 (if present) to the OFF position for normal operation.

6.2 Self Test Functions

(units prior to Software Revision 4.01)

The following text is a description of the self test functions performed by the infant warmer. If an error results on any of the power-up or on-line tests then the error number will be displayed on the elapsed time display in the format E ##. The high priority alarm (System Failure LED) will be ON and cannot be silenced. Power must be switched OFF to reset this alarm.

6.2.1 Power Up Testing

On power up the following tests are performed.

1. Instruction Test (Error #01)

   Selected instructions are tested and verified operational.

2. Checksum (Error #04)

   The hex values of EPROM locations from 0000 to 3FFD are added together and a 2 byte sum is stored. EPROM locations 3FFE and 3FFF contain a 2 byte number which when added to the calculated checksum should total zero.

3. RAM Test (Error #05)

   RAM locations 10 through 7F are tested with patterns of 00,FF,AA, and 55.

4. Test Port 1 Lines (Error #06)

   The port one I/O lines are tested to verify they can be toggled.

   NOTE: At power up the software revision number is displayed for 1 second in the elapsed time display, after the LED segment test.

6.2.2 On Line Testing

The following tests are run during the normal operation of the software. An error on any of these tests results in a System Failure alarm.

1. ADC Calibration Test (CAL High Error #02, CAL Low Error #03)

   Verifies that readings of the precision calibration resistors are within 0.3 degrees of the nominal values.

   These readings can be checked by depressing the hidden switch on the display panel (located directly above the alarm silence switch) for 2 seconds.

   After 2 seconds the displays should indicate as follows:

   Patient Temperature is 25.0 ± 0.3 degrees.

   Control Temperature is 37.9 ± 0.3 degrees.

2. Hardware Triac Test (E#025 03.11 Software only)

   A circuit independent of the microcontroller monitors that the microcontroller can switch the heat OFF. Every 3 minutes 24 seconds in 60 Hz operation (4 minutes and 5 seconds for 50 Hz operation) a request is made to the microcontroller to switch the heat OFF. If the heat does not go OFF, a hardware latch is latched and a relay contact is opened so there is no heat. This verifies that the triac is not shorted and that the microcontroller is still able to control the heat. This failure does not display an error number because it is not controlled by the microcontroller but will cause the software triac test to fail when heat is called for by the program.

3. ADC Convertor Not Converting (Error #07)

   Verifies that the ADC conversion complete occurs within 1 second.

4. Hardware Triac Timer Not Running (Error #08)

   Verifies that the request from the hardware triac test circuit occurs within 256 seconds.

5. Software Triac Test (Error #09)

   The heater status line is checked to verify that the heat is ON when the micro is switching it ON. This verifies that the triac is not failed open.

6. Line Voltage Out of Range (Error #10)

   Verifies that the line voltage is within the range of 82.6% to 117.4% of nominal input voltage. (95v to 135v, for 115v units)

6.2.3 On Demand Testing

Diagnostic testing can be accessed by one of the following:

1. Depressing and holding the Apgar Tones switch while powering up unit. This causes the unit to cycle in the self test loop until power is removed. See self test loop.

2. Selecting one of the test positions on the 4 position DIP switch located on the control board. Following is a description of the functions of the DIP positions:

   a. Switches All Open (OFF) Normal Operating Position.

   b. Switches 2,3,4, Closed (ON) and Switch 1 Open (OFF) Hardware Triac Test

      This mode is used to test the hardware triac test circuit. (See Section 4)

   c. Switches 1,2,3, Open (OFF) and Switch 4 Closed (ON)

      ADC Calibration

      The system displays the actual ADC counts on the elapsed time display, the patient temperature on the patient display even if outside of the normal displayed range, and the % of nominal line voltage on the control display. This position is used for calibrating the analog to digital converter and the line voltage compensation circuit.

   d. Switches 1,2,4 Open (OFF) and Switch 3 Closed (ON)

      Alarm Calibration

      All segments of all LEDs are lit. The heater, overhead alarm lamps, and the observation lamp are on. The audio alarm emits a steady low

      priority alarm sound. The 2 kHz alarm frequency can be adjusted using this mode.

   e. Switches All Closed (ON)

      Self Test Loop

      In this mode the unit cycles through a display test, checks ADC calibration, cycles the heater, alarm lights, and observation lights, and steps through the tests described in power up testing. It also monitors the touch switches and sounds the critical alarm while any switch is depressed. If any error occurs the error number will be displayed on the elapsed time display and the critical alarm will sound for two seconds. The program will then continue to loop through this test, even if the 4 DIP switches are returned to Open (OFF).

      If the test loop is entered on power up by depressing the Apgar Tones switch the program will loop until an error is detected. If an error is detected the unit will then stop the test loop, the error code will be displayed in the elapsed time display, and the critical alarm will sound. The power must be switched OFF to exit this mode.

6.2.4 Self Test Loop

The unit cycles in the following loop until the power is removed.

Power up tests performed:

Instruction test (Error #01)

Check calibrate high (Error #02)

Check calibrate low (Error #03)

Checksum (Error #04)

RAM test (Error #05)

Test port 1 lines (Error #06)

Check if ADC is converting (Error #07)

Display loop test:

Seven Segment Display's	Bar Graph Segments	Alarm LEDs	Mode LEDs	Heater & Lights
All 1's	1,11	Probe fail	Servo	ON
All 2's	2,12	Pat temp	Servo	OFF
All 3's	3,13	Sys fail	Servo	ON
All 4's	4,14	Heater OFF	Manual	OFF
All 5's	5,15	Reset timer	Manual	ON
All 6's	6,16	Spare LED	Manual	OFF
All 7's	7,17	All OFF	Apgar	ON
All 8's	8,18	All OFF	Apgar	OFF
All 9's	9,19	All OFF	Apgar	ON
All 0's	10,20	All OFF	All OFF	OFF
All OFF	All OFF	All OFF	All OFF	OFF

The unit returns to start of self test loop.

6.3 Troubleshooting Error Codes

Important: The recommended service policy is to limit repair procedures to sensor or board replacement, or in some cases the replacement of EPROMs. Additional information is provided for the purpose of identifying the faulty assembly.

Error codes are a subset of the system failure alarm. When an error code is triggered, an alternating two tone alarm sounds, the heater is automatically shut off, and normal warmer operation stops. However, the patient display continues to update, and the various on demand test functions are still available.

This section individually discusses each error code.

During a system failure alarm, the error code appears in the elapsed time display in the format E0##. A nonsilenceable, high priority alarm sounds and the System Failure LED illuminates. You must switch the power OFF to reset this alarm.

Note: Excessive EMI levels in the hospital environment can trigger the system failure alarm. Note the error code and switch off the unit. Wait ten seconds and switch the unit back on. If the system failure alarm recurs, remove the Infant Warmer from use until it has been repaired.

A. E01, Instruction Test Failure

A software routine executes selected instructions from the 8032 microcontroller. The results are then checked and if any mistakes are found this error is triggered.

To repeat the test, cycle the power off and back on. If the error recurs, replace the control board or kit.

B. E02, ADC High Calibration Failure

The reading from the ADC calibrate high resistor (5.76 kΩ), has exceeded the limits of 37.96 ± 0.3°C for one minute (or two consecutive ADC readings on boards prior to 4.01 software). This corresponds to a voltage of approximately 540 mV at the multiplexer input (U12 pin 14).

To see if the ADC requires calibration, depress the hidden switch located above Alarm Silence for five seconds; the low calibration test point (25.05 ± 0.3°C) will appear in the patient temperature display and the high calibration reading (37.96 ± 0.3°C) will appear in the control temperature display (except on IWS 2001 units, which do not have a control temperature display). If both readings exceed or nearly exceed the limits, calibration is required or resistor R30 may be out of tolerance. If the problem persists replace the control board or kit.

C. E03, ADC Low Calibration Failure

The reading from the ADC calibrate low resistor (10 kΩ), has exceeded the limits of 25.05 ± 0.3°C for one minute (2 consecutive readings on control boards prior to 4.01 software). This corresponds to a voltage of approximately 690 mV at the multiplexer input (U12 pin 13).

To see if the ADC requires calibration, depress the Start/Hold switch for five seconds; the low calibration test point (25.05 ± 0.3°C) will appear in the patient temperature display and the high calibration reading (37.96 ± 0.3°C) will appear in the control temperature display (except on IWS 2001 units, which do not have a control temperature display). If both readings exceed or nearly exceed the limits, calibration is required or resistor R29 may be out of tolerance. If the problem persists, replace the control board or kit.

D. E04, Checksum Failure

The results of the EPROM memory checksum differ from the correct result stored at memory locations 3FFE and 3FFF on U9.

There are no related test points. To repeatedly check for this alarm, switch off the unit and wait ten seconds; then switch it back on. If the error recurs, replace the EPROM (U9) and repeat the previous check. If the error recurs, replace the control board or kit.

E. E05, RAM Test Failure

The data read from a RAM memory location differs from the test pattern written to it.

There are no related test points. To repeatedly check for this alarm, switch off the unit and wait ten seconds; then switch it back on. If the error recurs, replace the control board or kit.

F. E06, Port 1 (Prior to 04.01 Software only)

Data being read back on Port 1 does not agree with the data written to the port. These signals cannot be monitored and there are no related test points. If the problem persists, replace the control board or kit.

G. E07, ADC Converter Failure

The Conversion Complete Signal from the ADC does not occur within five seconds of the Start Conversion signal from I/O expander U2.

Do not attempt to monitor these signals; the Start Conversion and the Conversion Complete pulses are extremely narrow with durations of only a few nano seconds. Verify that no conversions are being completed by heating or cooling the patient temperature probe and observing that the temperature display does not update, then replace the control board.

H. E08, Hardware Watchdog Timer (Software Revision 01.00 only)

The hardware watchdog timer is not functioning and timing out properly. There are no associated test points. Replace the control board.

I. E09, Heater Control (Prior to 04.01 Software only)

The heater triac or solid state relay or driving components are defective and are not allowing the radiant heat to be controlled. Verify that all the interconnecting cables are properly connected and making good electrical contact. Also verify for correct control signals from the control board. Replace the solid state relay (if applicable). If the problem persists, replace the power supply board.

J. E10, Line Voltage Out Of Range

Note: This alarm generally indicates a need for calibration.

The line voltage compensation signal from the power supply board converts to a voltage outside the allowed range, 82.6% to 117.4% of the nominal voltage (86.1% to 122.5% for 230 V). Line voltage fluctuation greater than 10% of a unit's nominal voltage will affect heater output.

Check the line voltage at the power outlet. If it is outside the alarm range, connect to a different power source. If it is within the acceptable range, calibrate the line voltage compensation circuit (see Section 4.2.6 or 4.3.5). If the circuit can't be calibrated or if the problem is interrmittent, replace the 16 pin ribbon cable between the power supply and the control boards. If this does not correct the problem, replace the power supply board.

Labeled Voltage	Nominal Voltage	Power Supply Range (alarm limits)
100 V	95 V	82.6 to 117.4 V
120 V	115 V	95 to 135 V
220 V	220 V	181.7 to 258.3 V
230 V	230 V	198.2 to 281.8 V
240 V	240 V	198.2 to 281.8 V

K. E12, Heater Not Switching On (Revision 04.01 Software and higher)

The microcontroller has commanded the heater to switch on (U1 pin 16 high) but the heater status signal indicates that the heater is off (U2 pin 14 low; heater status LED off).

Verify the proper heater command and the heater status signal levels. Also verify that heater rod wires are properly connected and making good electrical contact. The most probable cause of this alarm is an open solid state relay (or triac in some older IWS models) or a problem in the power supply board's heater drive circuit. Replace solid state relay (if applicable). If problem persists, replace power supply board.

L. E13, Heater Not Switching Off (Revision 04.01 Software and higher)

The microcontroller has commanded the heater to switch off (U1 pin 16 low) but the heater status signal indicates that the heater is on (U2 pin 14 high; heater status LED illuminated).

Verify the proper heater command and the heater status signal levels. Also verify that heater rod wires are properly connected and making good electrical contact. The most probable cause of this alarm is a shorted solid state relay (triac in some older IWS models) or a problem in the power supply board's heater drive circuit. Replace solid state relay (if applicable). If problem persists, replace power supply board.

M. E14, Alarm Oscillator Failure (Revision 04.01 Software and higher)

An alternating two tone alarm signal has been activated (high priority alarm line) but the 2 kHz signal at test point 1 (also U2 pin 16) is not toggling.

To troubleshoot this failure, an alternating two tone alarm must be active. To activate the alarm circuit, depress the Reset switch during power up. If the problem persists, replace the control board.

N. E15, Software Upset RAM Error (Revision 04.01 Software and higher)

A software upset has caused the watchdog timer to time out and the system is unable to recover because critical parameters (e.g. control temperature) stored in the RAM may have been altered. This error does not necessarily indicate a hardware failure.

Note: Excessive EMI levels in the hospital environment can trigger the system failure alarm. Note the error code and switch off the unit. Wait ten seconds and switch the unit back on. If the system failure alarm recurs, remove the warmer from use until it has been repaired.

Switch the unit off and back on. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Apgar Tones switch for at least five seconds. If PFF appears in the patient temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service. If another value appears in the patient temperature display, replace the control board.

O. E16, Safety Relay Not Opening Properly (Revision 04.01 Software and higher)

On power up, the software performs tests to verify that, if the watchdog timer is not pulsed, the safety relay opens. If the microcontroller does not sense the contacts opening, the System Fail Alarm is activated.

To repeat the test, cycle the power off, wait ≈5 seconds, then turn the power back on.

The most likely cause for this failure is a defective power supply board, but it can also be caused by a bad control board.

P. E17, Software Upset (Revision 04.01 Software and higher)

For some unknown reason, the software is not cycling through all of the routines and is unable to recover. This error does not necessarily indicate a hardware failure.

Note: Excessive EMI levels in the hospital environment can trigger the system failure alarm. Note the error code and switch off the unit. Wait ten seconds and switch the unit back on. If the system failure alarm recurs, remove the warmer from use until it has been repaired.

Switch the unit off and back on. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Apgar Tones switch for at least five seconds. If PFF appears in the patient temperature display, no software upsets have occurred. Complete the Checkout Procedure and return the unit to service. If another value appears in the patient temperature display, replace the control board or kit.

Q. E19, Software Upset (Revision 04.01 Software and higher)

The watchdog timer has timed out 256 times since power up. This error can be caused by a software upset. This error does not necessarily indicate a hardware failure.

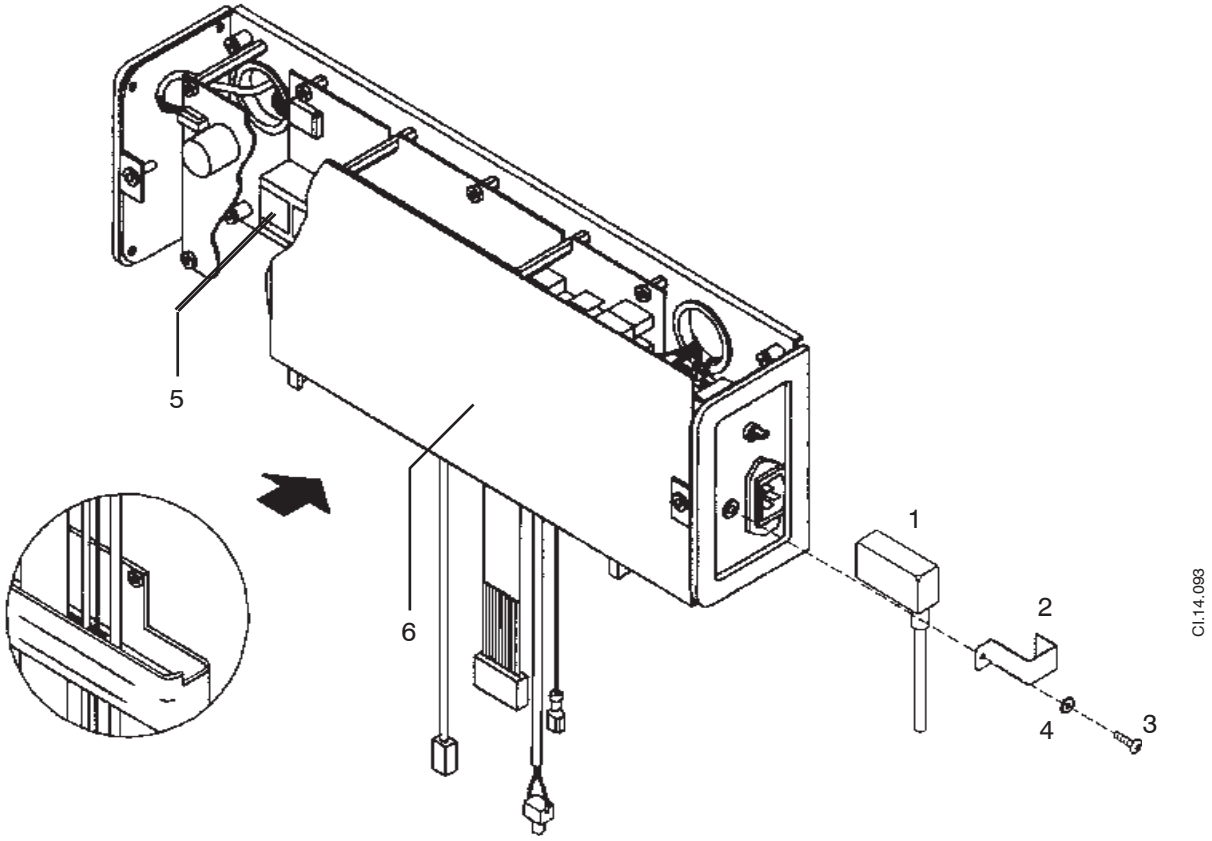
Note: Excessive EMI levels in the hospital environment can trigger the system failure alarm. Note the error code and switch off the unit. Wait ten seconds and switch the unit back on. If the system failure alarm recurs, remove the warmer from use until it has been repaired.

Switch the unit off and back on. If the error does not recur, allow the unit to run for half an hour. Then check the number of recoverable software upsets that have occurred by depressing and holding the Apgar Tones switch for at least five seconds. If PFF appears in the patient temperature display no software upsets have occurred. Complete the Checkout Procedure and return the unit to service. If another value appears in the patient temperature display, replace the control board or kit.

R.E25, Watchdog Circuit Tripped (Software Revision 3.11 Only)

This alarm only triggers in units with software 03.11. It Signals that the heat is not being controlled properly. Switch the unit off and back on. Turn the heat off in the manual mode. Observe LED DS1 on the control board. If the LED is off and the alarm trips the control board is probably defective. If the LED is on either the power supply or the SSR is probably defective.

7.1 Infant Warmer Controller Assembly-1 (All Models)



Description	Stock Number
1. Power Cord 100/120V units	0208-0950-300
Power Cord 220/230/240V units (except Australia)	6600-0574-612
Power Cord 240V unit (Australia)	6600-0574-613
2. Plug Guard	6600-0572-500
3. Screw 8-32 x 3/8	6600-0261-400
4. Lock washer, internal #8	6600-0262-400
5. Rechargeable 7.2 Battery	0690-1000-310
6. Control Board ESD Shield†*	6600-0509-500

†Included with noise suppression kit, see page 7-84

* Not present on all units.

Figure 7-1
Infant Warmer Controller Assembly 1 (All models)

7.2 Infant Warmer Controller Assembly-2 (All Models)

	Description	Stock Number
1.	Phone Jack Bezel (black)	0217-5219-100
	Phone Jack Bezel (grey)	6600-0798-501
2	Bezel Label- English	6600-1975-101
	Bezel Label- French	6600-1975-102
	Bezel Label- Spanish	6600-1975-103
	Bezel Label- German	6600-1975-104
	Bezel Label- Italian	6600-1975-105
	Bezel Label- Swedish	6600-1975-106
	Bezel Label- Japanese	6600-1975-107
3.	Patient Cable Harness Assy Kit (includes item 4)	6600-0540-800
4.	Washer, flat	6600-0455-400
5.	Display Board	6600-0102-850
6.	Standoff	0402-0233-300
7.	Brass Washer	0202-4510-300
8.	Screw, 8-32 x2 1/4	0140-4127-236
9.	Screw #6 x 5/8	0142-2833-210
10.	Display box bottom cover* (beige)	6600-0521-500
	Display box bottom cover (light grey)	6600-0521-501
11.	Display box top cover* (beige)	6600-0522-500
	Display box top cover (light grey)	6600-0522-501
12.	Switch panel label -English@	See Label Section
13.	Nut, 6-32 Hex	0144-3324-113
14.	Ground label**	0205-4737-300
15.	Display box grounding spring‡	
16.	Tab Faston 250 SER‡	
17.	Lock washer, #6 int‡	
18.	Display Board ESD Shield†**	6600-0508-500
19.	Snap dome switch panel@	
	Units with HAK, AAN & HCA-Series 3000 & 4000, Model 5000	0208-5129-300
	Units with HCC-Series 3000 & 4000, Model 2001	6600-0468-700
	Model 2001 (Units with HAJ & HCA)	6600-0136-700
20.	Model Number Insert label@	See Label Section
21.	Footswitch cable, controller (Type 2 elevating base units only)	6600-0479-700
22.	ESD cable (for grounding see Figure 7-5)	6600-0541-700

Parts not shown

Skin Temperature Probe LA003 (reusable)	0208-0697-700
Reflective patches, 50/pkg (used with LA003)	0203-1980-300
Skin Temperature Probe LA005 (disposable) pkg/10	6600-0208-700
Probe LA005 pkg/50	6600-0196-700

@ The label adhesive is included on snap dome panel (item 19). Always replace items 12 & 20 when replacing item 19, and always replace item 19 when replacing item 12.

* Replace both top and bottom panels to ensure a match

‡No longer required, may be removed.

†Included with noise suppression kit, see page 7-90

**Not present on all units

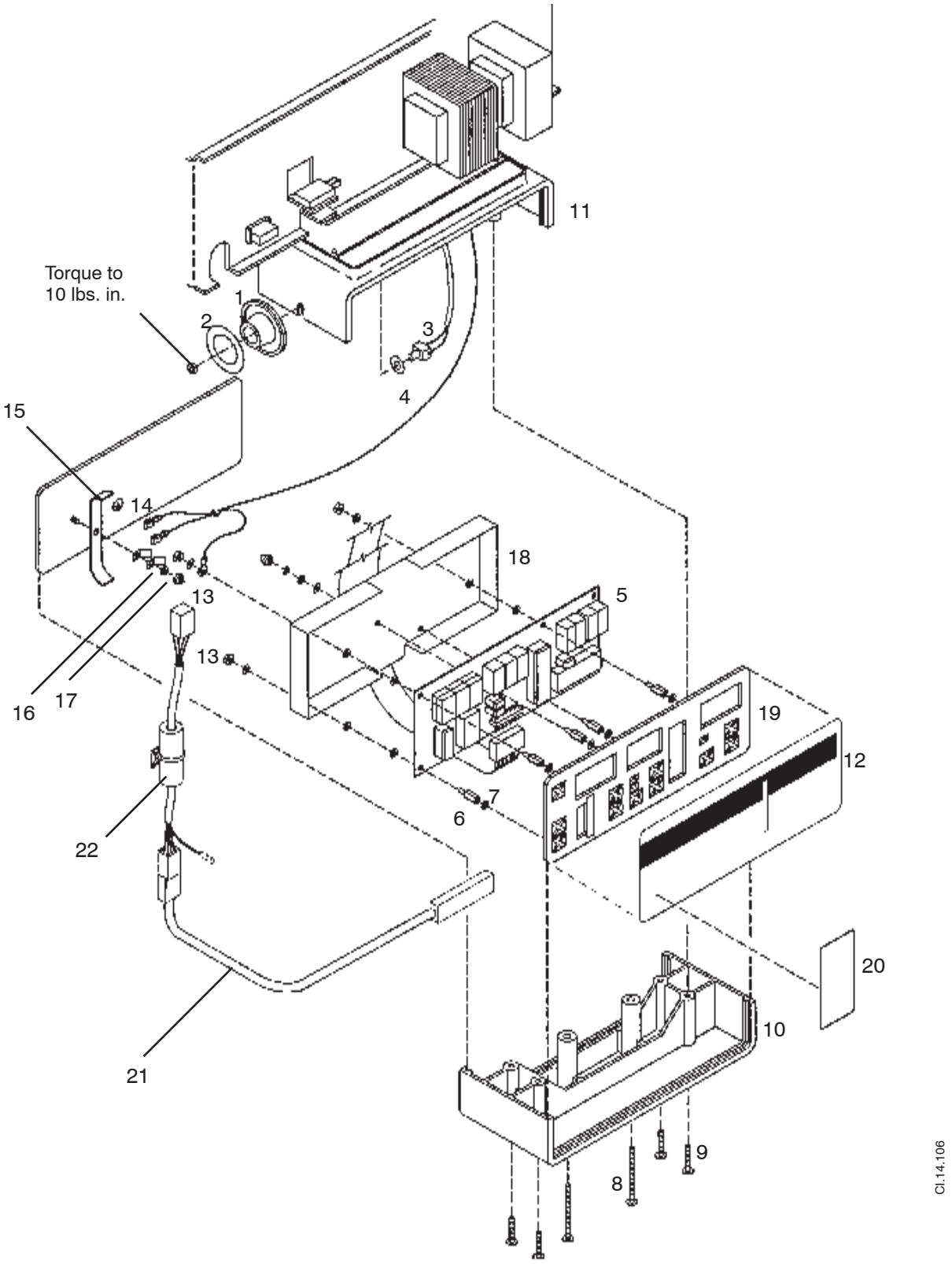


Figure 7-2
Infant Warmer Controller Assembly 2 (All models)

7.3 Infant Warmer Controller Assembly-3 (2001, 3000, 3300, 3500 w/o HCA)

	Description	Stock Number
1.	Lock Nut 8-32 w/Ext Lock Washer	0202-1131-300
2.	Wire tie push mount	6600-0262-600
3.	External Lock Washer	6600-0379-400
4.	Screw, 8-32 x 1/2	6600-0390-400
5.	Transformer 95,115, 220, 240 Vac Input 8 to 13 Vac Output	0208-7580-300
6.	Transformer 95,115, 220, 240 Vac Input 12 Vac Output	0208-7581-300
7.	Hex nut 4-40	0144-3217-113
8.	Internal #4 Lock Washer	0144-1104-131
9.	Mounting Plate	0214-2275-711
10.	Micro Switch (1 amp)	0208-5163 300
11.	Screw, 4-40 x 5/8	6600-0381-400
12.	External #6 Lock Washer	0202-3200-300
13.	Screw, 6-32 x 1/2	6600-0259-400
14.	Screw #6 x 5/8	0142-2833-210
15.	Display Box Mounting Bracket	0214-1571-500
16.	Flat washer	0202-4518-340
17.	Control Board ESD Shield†*	6600-0509-500

†Included with noise suppression kit , see page 7-80

* Not present on all units.

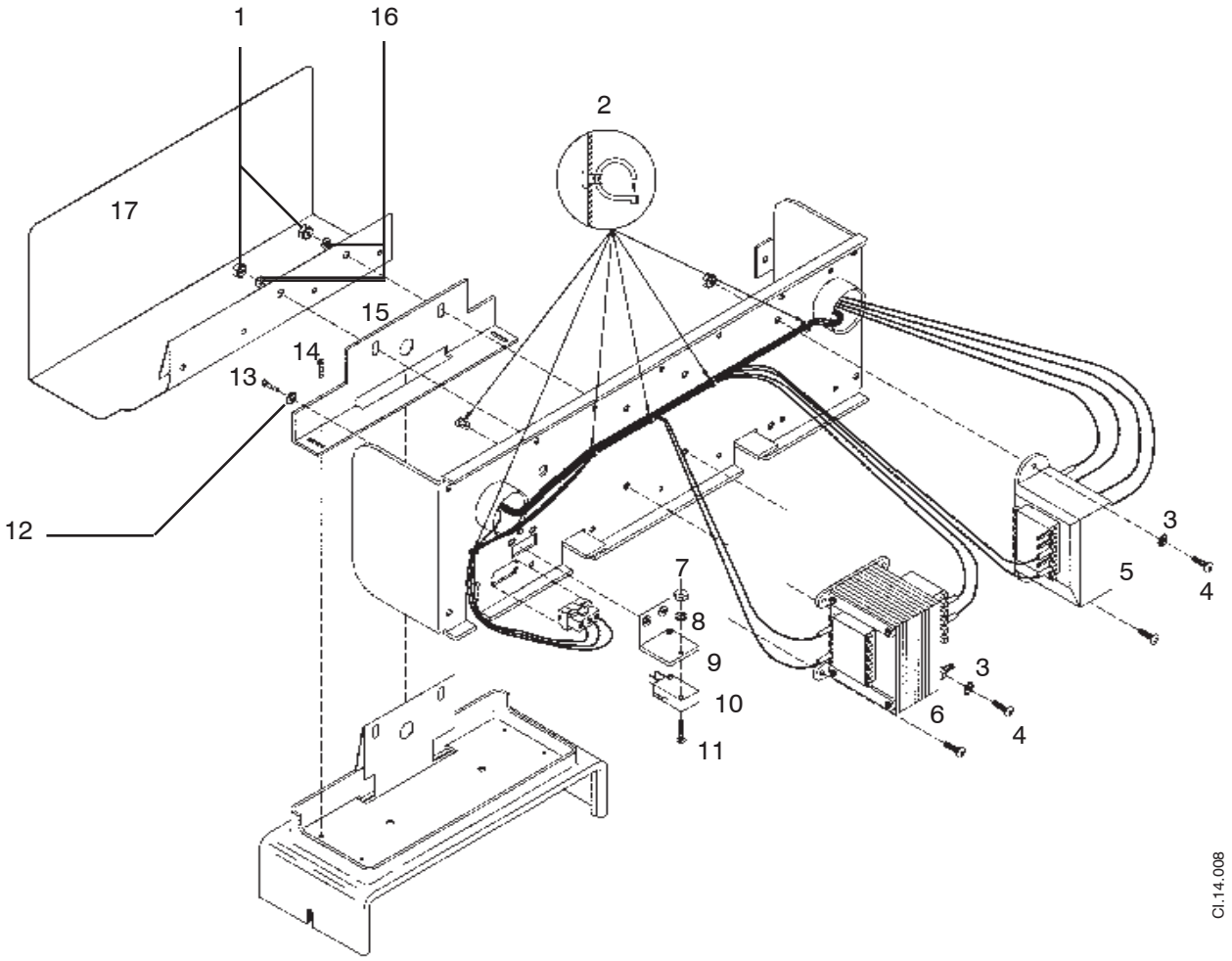
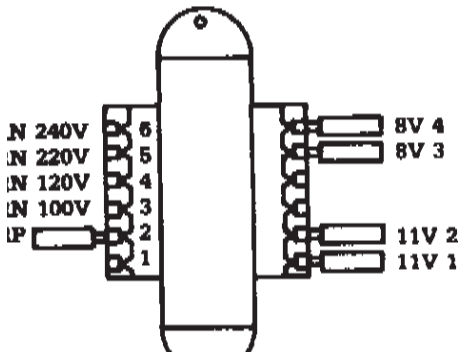
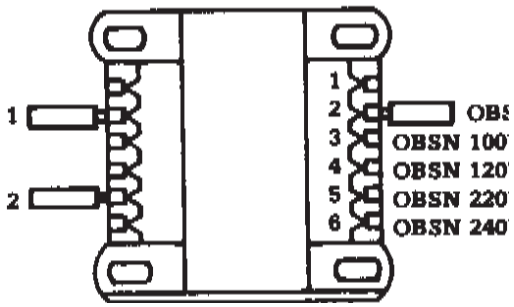


Figure 7-3
Infant Warmer Controller Assembly 3 Series 3000, and 2001
with serial numbers that begin with HAK,HAJ or AAN

7.4 Infant Warmer Controller Assembly-4 (5000 and all Models with HCA)



For 100 V Version, connect to 2 & 3
For 120 V Version, connect to 2 & 4
For 220 V Version, connect to 2 & 5
For 230 V Version, connect to 2 & 6
For 240 V Version, connect to 2 & 6



For 100 V Version, connect to 2 & 3
For 120 V Version, connect to 2 & 4
For 220 V Version, connect to 2 & 5
For 230 V Version, connect to 2 & 6
For 240 V Version, connect to 2 & 6

CI.05.036

	Description	Stock Number
1.	Lock Nut 8-32 w/Ext Lock Washer	0202-1131-300
2.	Wire tie push mount	6600-0262-600
3.	External Lock Washer	6600-0379-400
4.	Screw, 8-32 x 1/2	6600-0390-400
5.	Transformer 95, 115, 220, 230, 240 Vac Input 8 to 13 Vac Output	0208-7580-300
6.	Transformer 95, 115, 220, 230, 240 Vac Input 12 Vac Output	0208-7581-300
7.	Hex Nut 4-40	0144-3217-113
8.	Internal #4 Lock Washer	0144-1104-131
9.	Mounting Plate (left hand)	0214-2275-711
10.	Micro Switch (1 amp)	0208-5163-300
11.	Screw, 4-40 x 5/8	6600-0381-400
12.	External #6 Lock Washer	6600-0259-400
13.	Screw, 6-32 x 1/2	0140-6124-108
14.	Screw #6 x 5/8	0142-2833-210
15.	Display Box Mounting Bracket	0214-1571-500
16.	Solid State Relay	6600-0457-800
17.	Flat washer	0202-4518-340
18.	Control Board ESD Shield†*	6600-0509-500
19.	Mounting plate (right-hand)	6600-1515-500

† Included with noise suppression kit, see page 7-84

* Not present on all units.

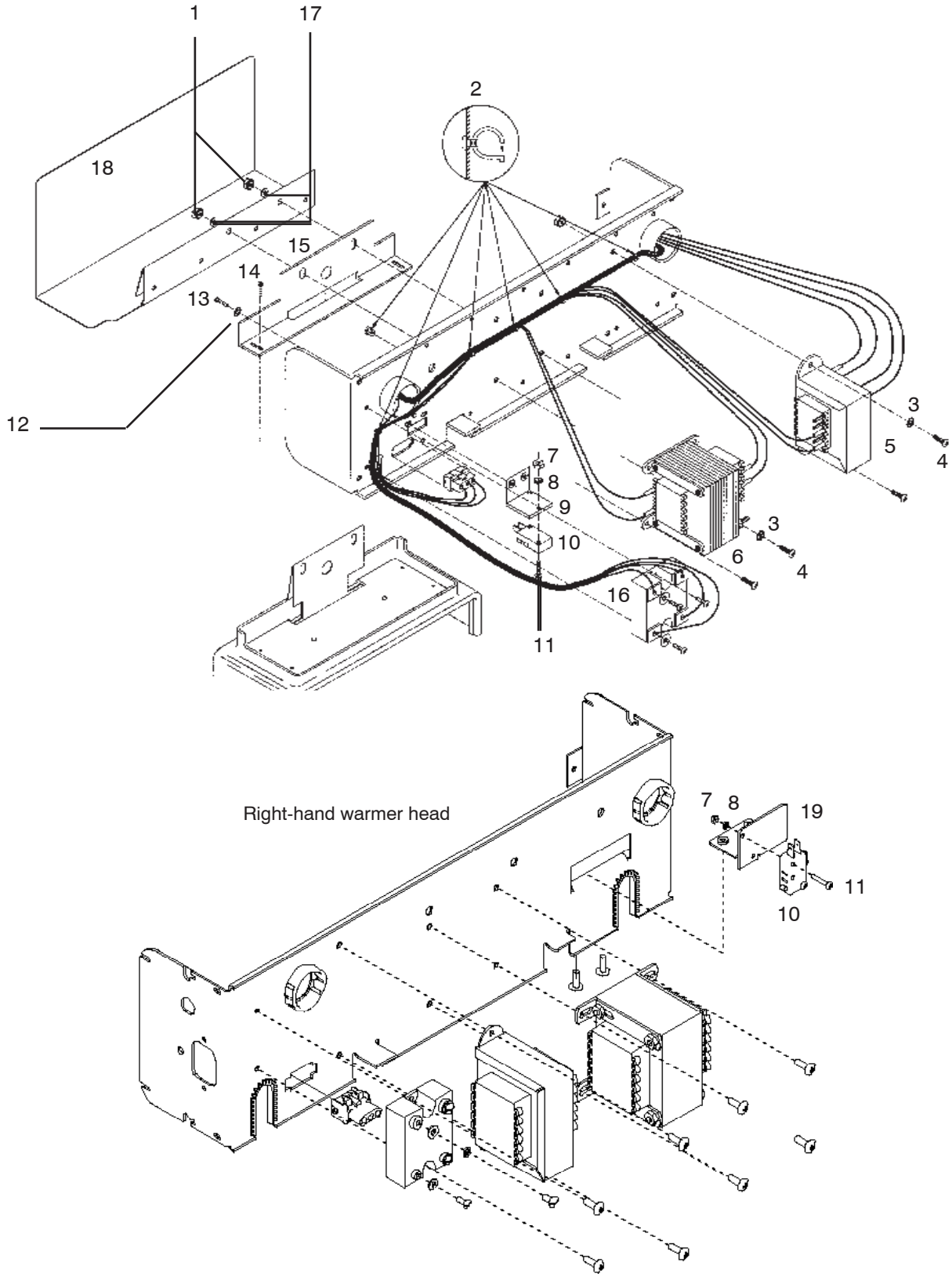
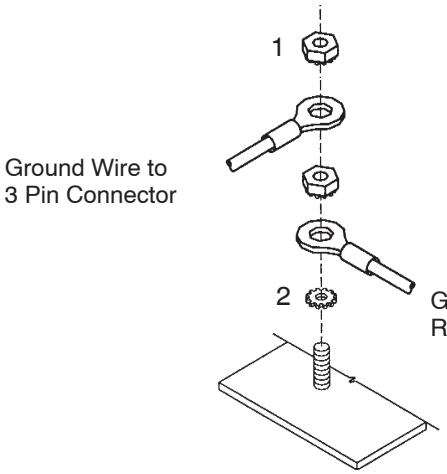


Figure 7-4
Infant Warmer Controller Assembly 4
Model 5000 and all models with HCA or HCC serial numbers

7.5 Infant Warmer Controller Assembly-5 (All Models)



	Description	Stock Number
1.	Lock Washer 8-32 w/Ext Lock Washer	0202-1131-300
2.	External Lock Washer	6600-0379-400
3.	Screw, 6-32 x 1/2*	0140-6124-108
4.	External #6 Lock Washer*	6600-0259-400
5.	Snap Split Bushing	6600-0383-400
6.	Lock Nut #6-32	6600-0382-400
7.	Screw 8-32 x .5	0140-6627-108
8.	Power Cord Line Filter (install from inside)	6600-0170-600
9.	Nylon Grommet	0211-1472-300
10.	Toggle Switch dpst/circuit breaker	0690-2500-365
11.	Controller Wire Harness	
	Model 2001 & Series 3000 with AAN, HAJ and HAK serial number	0208-6181-700
	Model 5000 with AAN serial number	6600-0006-700
	All models with HCA and HCC serial number (left-hand)	6600-0333-700
	All models with HCC serial number (right-hand)	6600-0587-700
12.	Cable Assy, 16 Conductor	6600-0211-700
13.	Cable Assy, 12 Conductor	6600-0261-600
14.	Control Board (for units with ESD shielding in place)†	6600-0101-850
15.	Power Supply Board	
	Model 2001 & Series 3000 with AAN, HAJ and HAK serial number	6600-0180-700
	Model 5000 100/120 V with AAN serial number	6600-0182-700
	Model 5000 220/230/240 V with AAN serial number	6600-0184-700
	All models with HCA or HCC serial number	6600-0012-850
16.	Spacer 1/4" Hex 6-32 x 3/4	0402-0234-300
17.	Spacer 1/4" Hex 6-32 x 2	0402-0236-300
18.	Screw #4 x 5/16	6600-0013-400
19.	Control Board ESD Shield†*	6600-0509-500
20.	Standoff, 6-32 x 3/4, Nylon	6600-0479-400
21.	Battery	0690-1000-310
22.	Lockwasher, #6 ext tooth	6600-0259-400
23.	Screw, 6-32 x 3/8 RD, PH	0140-6124-106

†If your unit has no shielding see page 7-90 for a complete noise suppression kit.

* Not present on all units.

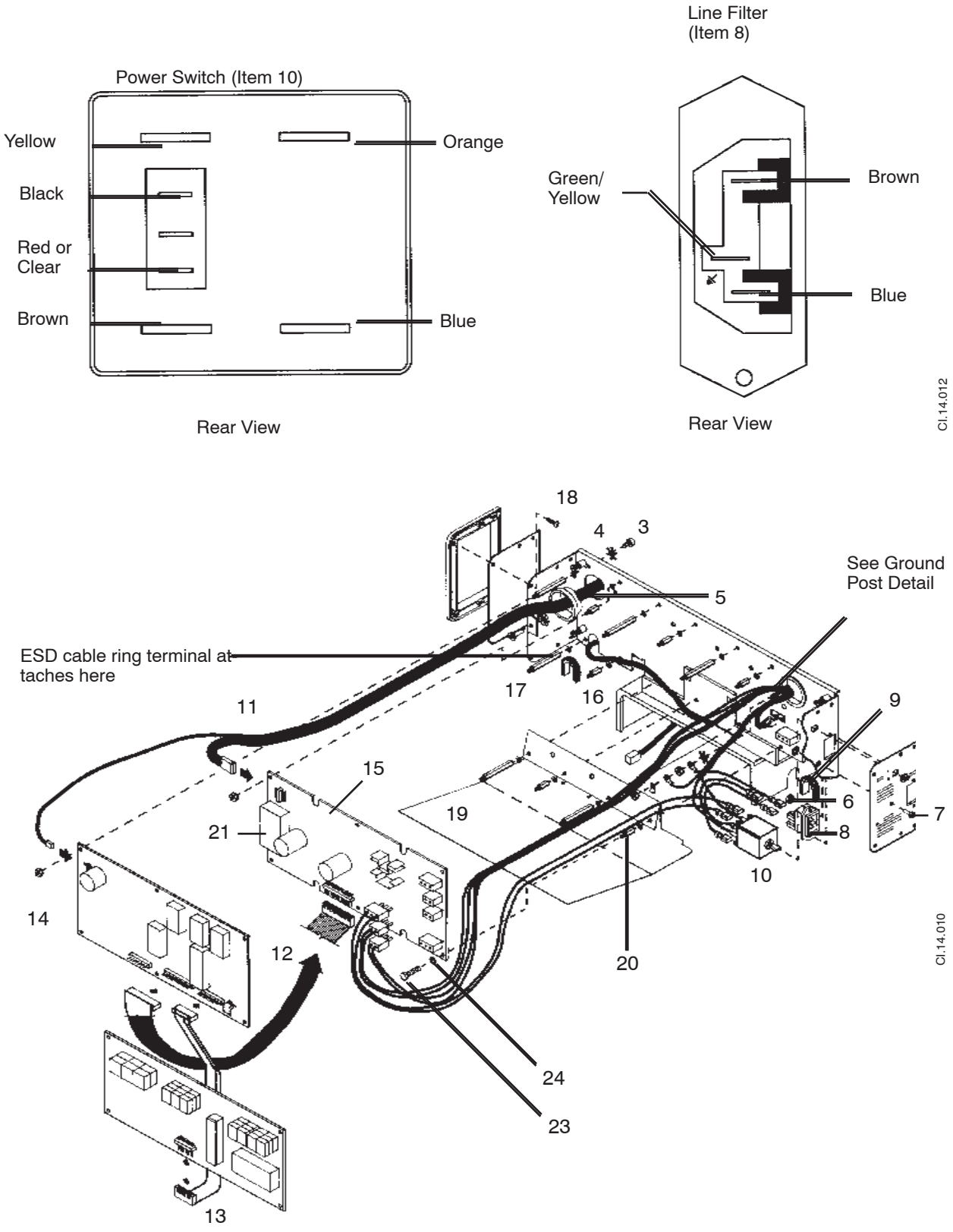


Figure 7-5
Infant Warmer Controller Assembly 5 (All models)

7.6 ThermaLink Option Assembly

	Description	Stock Number
1.	ThermaLink ribbon cable assembly	6600-0346-700
2.	ThermaLink chassis	6600-0550-500
3.	ThermaLink board*	6600-0074-850
4.	Controller label	6600-1931-101
5.	"D" channel (beige)	0217-5320-100
	“D” channel (light grey)	6600-0803-501
6.	ThermaLink wire harness assembly (only fits board without test switch)	6600-0530-700
7.	ThermaLink chassis cover	6600-0551-500
8.	Lock washer, #4 int	0202-3407-300
9.	Screw, 4-40 x 1/4 Phillips	6600-0125-400
10.	Screw, 6-32 x 1/4 PH SST	0140-6624-104
11.	Lock washer, #6 int	0202-3412-300
12.	Screw, #8- 32 x 9/16	0140-6627-109
13.	Lock washer, #8 int	6600-0262-400
14.	Retainer clip	6600-0672-400
15.	Screw lock	6600-0763-400

* PC board without test switch on board. To replace boards with on board test switch, order upgrade kit listed below.

ThermaLink upgrade kit (units with 5.0 or higher software only) .. 6600-0001-850

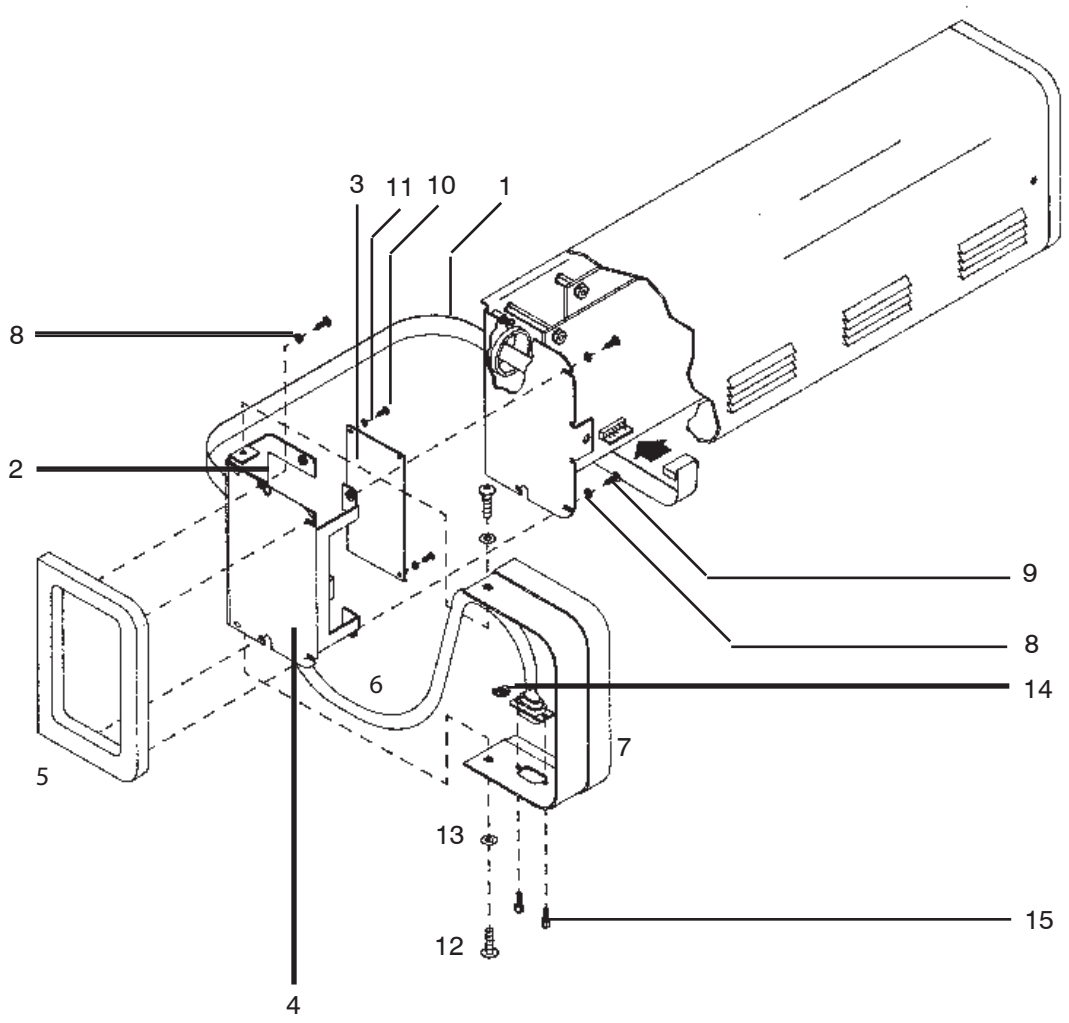


Figure 7-6
ThermaLink option assembly

7.7 Infant Warmer Frame Assembly (3000/3300/4000/4300)

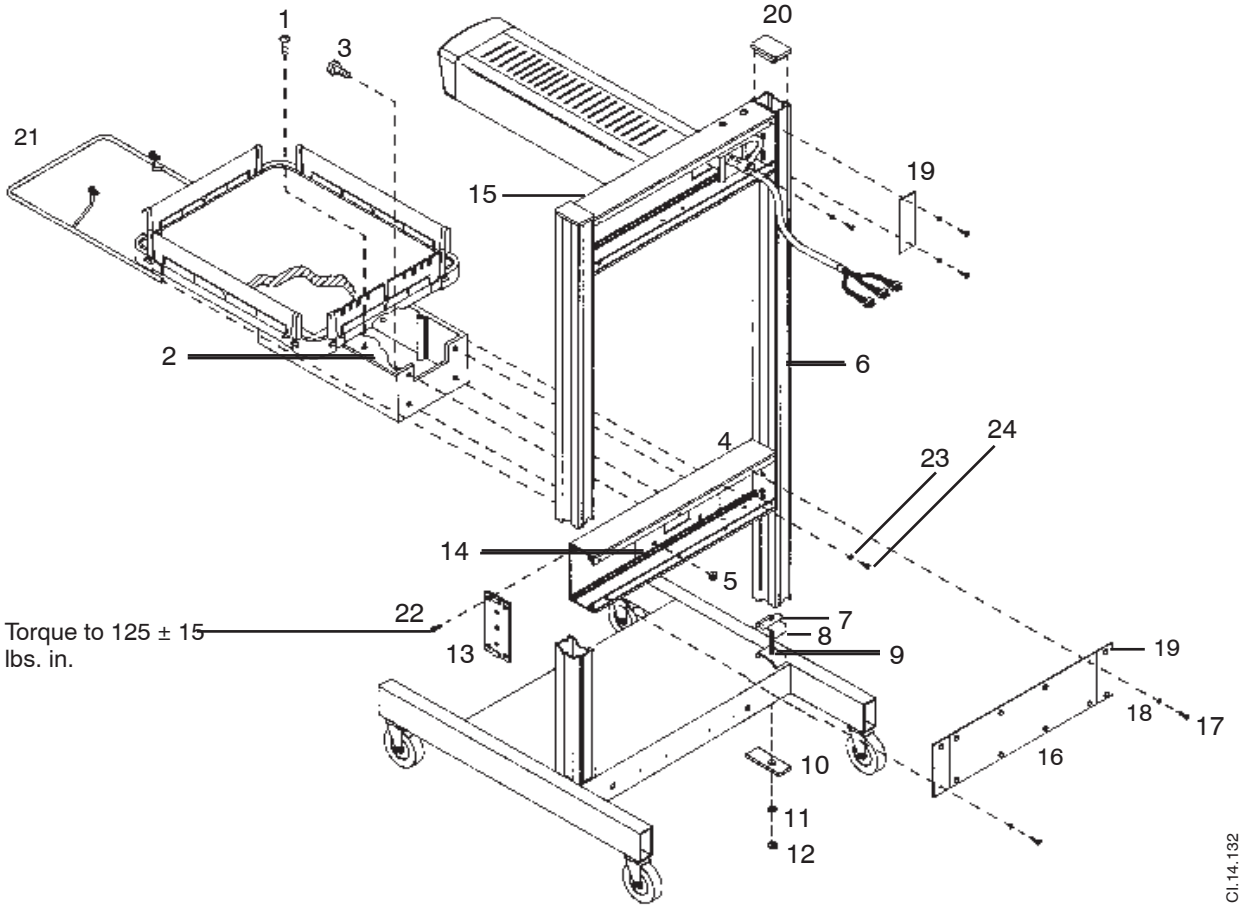
	Description	Stock Number
1.	Screw 10-24 x 5/16	0140-6530-105
2.	Bed support cover (beige)	6600-0805-502
	Bed support cover (light grey)	6600-0805-501
3.	Screw, 3/8-16 x 1-1/4"	6600-0645-400
4.	Lower cross support (3300)	0217-5269-300
	Lower cross support (4300)	6600-0326-400
5.	Nut, elastic 3/8-16	6600-0266-400
6.	Upright with dovetails‡	0217-5266-300
7.	Upright mounting bar	0217-5296-542
8.	Tie-rod centering bracket	0214-1554-500
9.	Upright tie-rod 1/2-13 x 6"	0217-5284-300
10.	Reinforcing plate (used on both cross members)	6600-0233-500
11.	Lock washer 1/2 int	0202-3425-300
12.	Locking nut 1/2-13	6600-0263-400
13.	Locking lug assembly	6600-0339-700
14.	Support plate	0214-1558-511
15.	Upper cross member, beige (model 3000 & 3300)	6600-0341-700
	Upper cross, grey (model 3000 & 3300)@	6600-0341-705
	Upper cross, beige (wall mounted units)	6600-0341-704
	Upper cross member, beige (series 4000)	6600-0341-703
	Upper cross member, grey (series 4000)@	6600-0341-707
	Upper cross, grey (wall mounted units)@	6600-0341-708
	Upper cross, grey (right-hand units)@	6600-0589-709
16.	Cover, cross member	0214-1550-549
17.	Screw 8-32 x 3/8	6600-0261-400
18.	Lock washer, #8 int	6600-0379-400
19.	Cover*	6600-0450-500
20.	End cap (black)	0217-5286-100
	End cap (grey)	6600-0703-501
21.	Chest drainage hanger	6600-0477-500
	Chest drainage hanger kit (template & hdwr)	6600-0274-800
22.	Screw 1/4 x 1	0142-4247-116
23.	Lock washer, 1/2 x .039 int	0202-3210-340
24.	Screw, 10-24 x 1/2, TRS PH SST†	0140-6630-108
25.	Base spacer plate (Model 4300 only)	6600-0614-500
26.	Support post plate (Model 4300 only)	6600-0612-500
27.	Support post, beige units (Model 4300 only)	6600-0453-400
	Support post, grey unts (Model 4300 only)	6600-0648-400
28.	Support post bracket (Model 4300 only)	6600-0613-500

*Not present on all units

†Use Loctite #24231 (6600-0058-300)

‡ Must order load limit and bed height labels. See label section.

@ Must order label number 6600-1295-xxx. See label section.



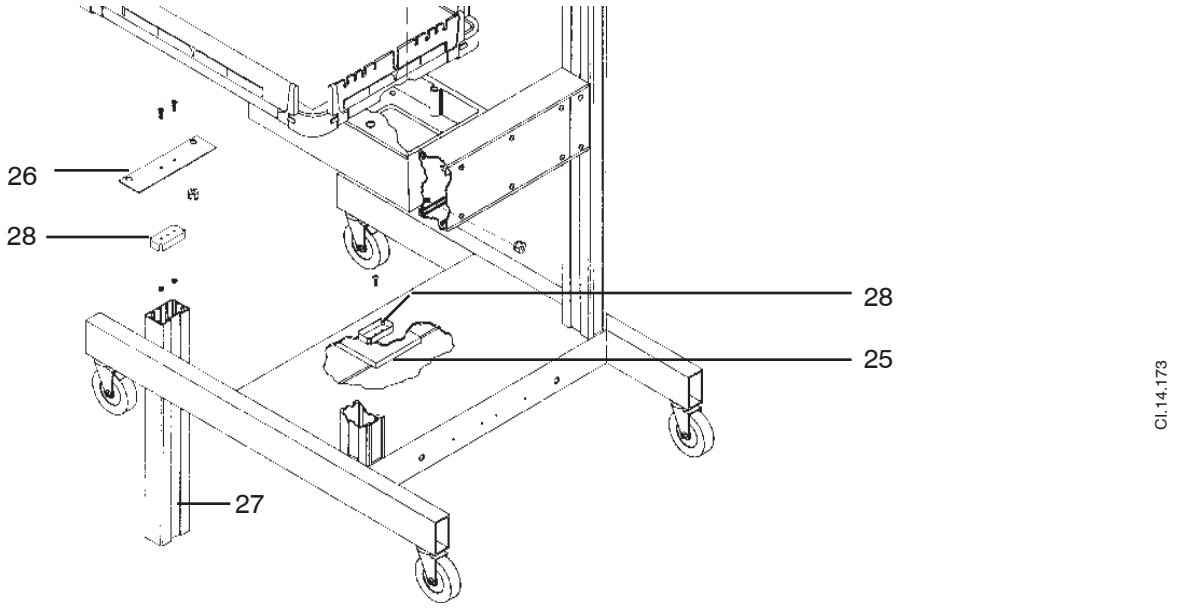


Figure 7-7
Infant Warmer Frame Assembly (Models 3000, 3300, 4000, and 4300)

7.8 Base Assembly (3000/3300/4000/4300)

	Description	Stock Number
1.	Cast Iron Base Weight (used on non-elevating models)	0217-5038-100
2.	Locking 5" Caster (black)	0215-8105-300
	Locking 5" Caster (grey)	6600-0569-400
3.	Non-Locking 5 Caster (black)	0215-8104-300
	Non-Locking 5 Caster (grey)	6600-0568-400
4.	Locking Nut	6600-0263-400
5.	Weight Support Rod	0217-5295-542
6.	Screw 5/16-18 x 1	0144-2440-216
7.	Pyramidal Lock washer	0202-3419-300
8.	Right Leg Kit (model 3000)	6600-0245-800
	Right Leg Kit (model 2001/3300)	6600-0250-800
	Right Leg Kit (4000)	6600-0021-850
	Right Leg Kit (3400, 4300 & 4400)	6600-0023-850
9.	Left Leg Kit (model 3000)	6600-0246-800
	Left Leg Kit (model 2001/3300)	6600-0249-800
	Left Leg Kit (4000)	6600-0022-850
	Left Leg Kit (3400, 4300 & 4400)	6600-0024-850
10.	Screw 5/16-18 x 1	0144-2440-216
11.	Base plate, beige (3000/3300)	0214-1553-710
	Base plate, light grey (3000/3300)	6600-0466-701
	Base plate, beige (4000/4300)	6600-0336-700
	Base plate, light grey (4000/4300)	6600-0336-701
12.	Hole Plug	0203-0232-300
13.	End Cap (black)	6600-0520-500
	End Cap (grey)	6600-0520-501

Note: Base weights have cork material attached for noise damping.

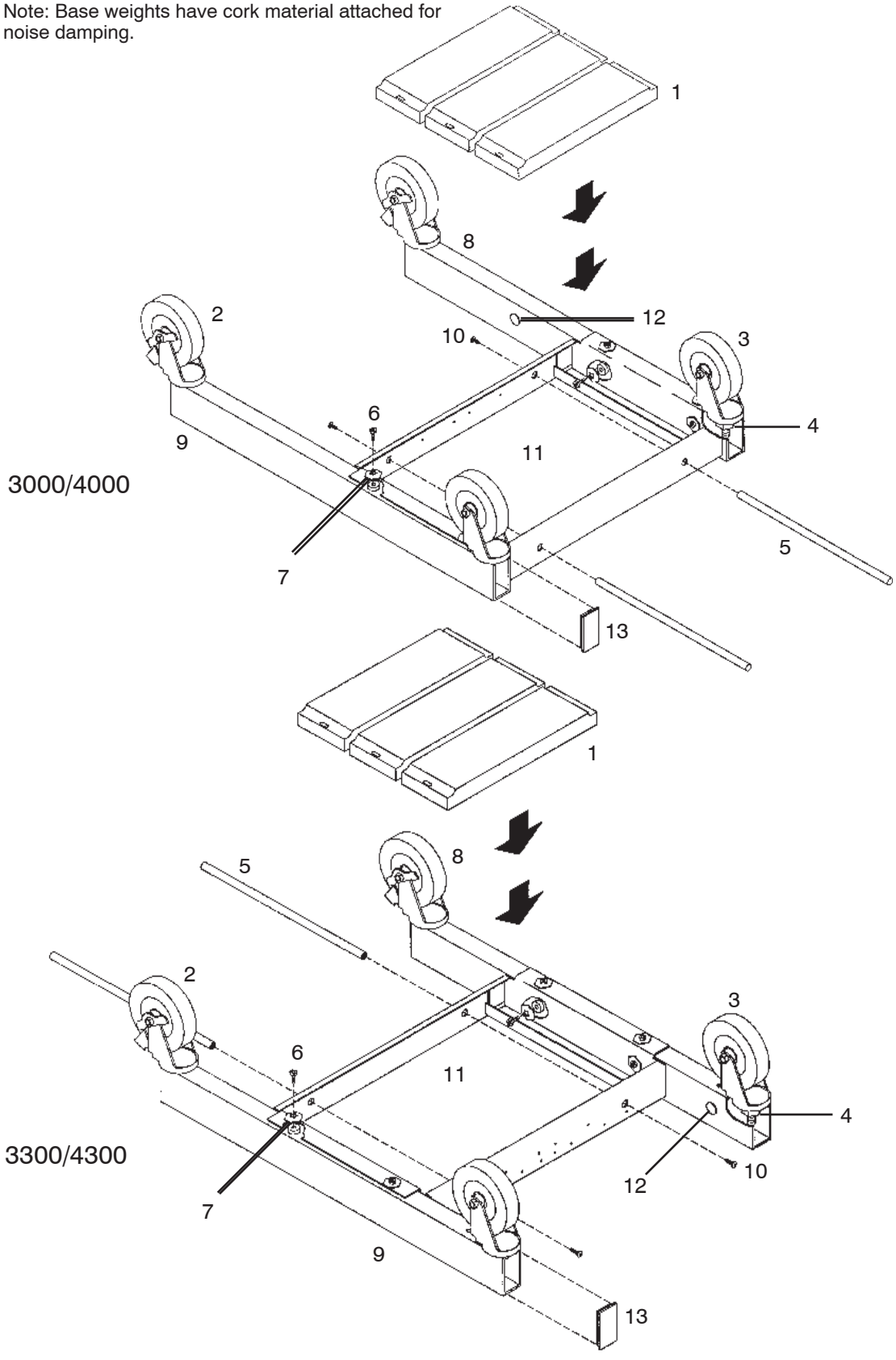
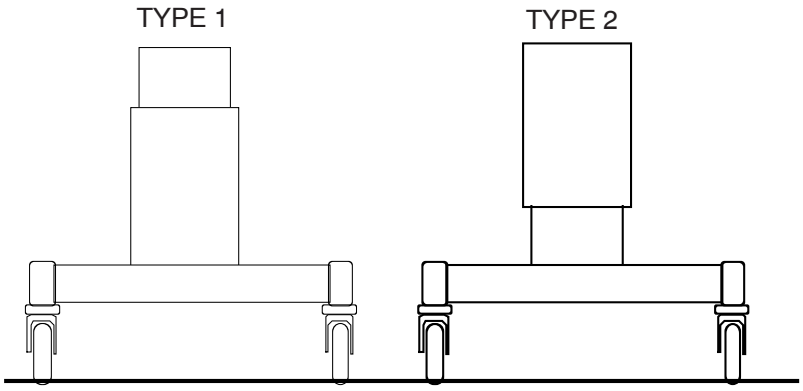


Figure 7-8
Base Assembly (Models 3000, 3300, 4000, and 4300)

7.9 Infant Warmer Frame Assembly (3400/4000/5000)



	Description	Stock Number
1.	Screw 10-24 x 5/16	0140-6530-105
2.	Bed support cover (beige)	0214-1559-510
	Bed support cover (grey)	6600-0805-501
3.	Screw, 3/8-16 x 1-1/4	6600-0645-400
4.	Nut, 3/8 - 16, elastic locking	6600-0266-400
5.	Lower cross support (5000)	0217-5180-300
	Lower cross support (4400)	6600-0326-400
	Lower cross support (3400)	0217-5269-300
6.	Nut, elastic 3/8-16	6600-0266-400
7.	Upright with dovetails (5000)	0217-5178-300
	Upright with dovetails (3400 & 4400)	6600-0454-500
8.	End cap (black)	0217-5286-100
	End cap (grey)	6600-0703-501
9.	Screw, 1/4 x 1	0142-4247-116
10.	Support plate	0214-1558-511
11.	Locking lug assembly	6600-0339-700
12.	Leg weight (3400 & 4400 - units without drawers)*	6600-0444-400
13.	Screw 8-32 x 1/2	0140-6627-108
14.	Upper cross assembly (includes cross member, locking lugs and heater hinge assy)	
	(5000) beige	6600-0341-701
	(3400) grey†	6600-0341-705
	(4400) beige	6600-0341-703
	(4400) grey†	6600-0341-707
15.	Cover	0214-1550-549
16.	Screw, 8-32 x 3/8	6600-0261-400
17.	Lock washer, #8	6600-0262-400
18.	Cover, cross member (5000)	6600-0450-501
	Cover, cross member (4400)	6600-0450-500
19.	Chest drainage hanger	6600-0477-500
	Chest drainage hanger kit (template & hdwe)	6600-0274-800
20.	Screw, PH HD 10-24 x 1/2	0140-6630-108
21.	Lock washer, INT	0144-1110-131
22.	Footswitch cable, upright (Type 2 elevating units only)	6600-0480-700

* If drawers are removed, a weight must be installed in the right leg. See Warning on page A-16.

† Order label set when replacing cross assembly. See label section.

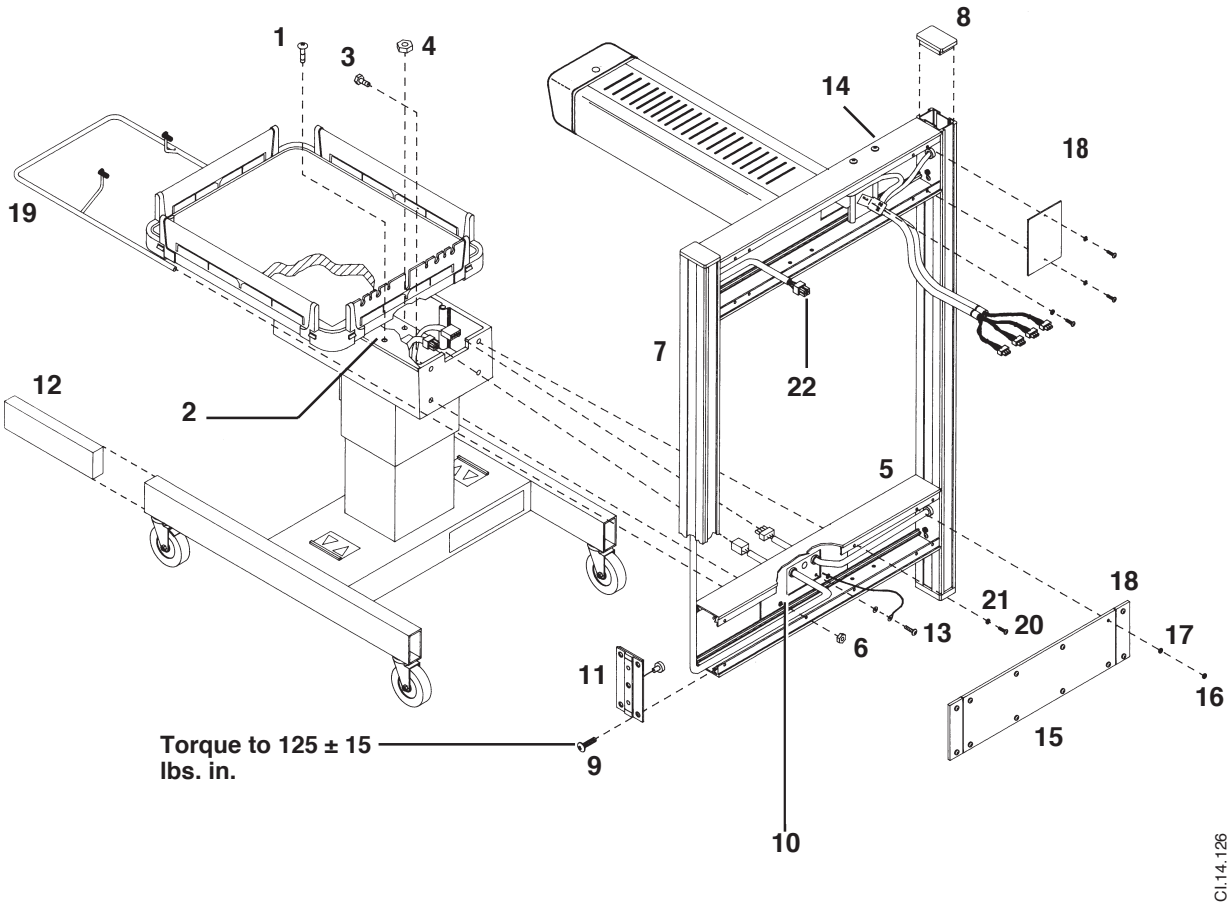
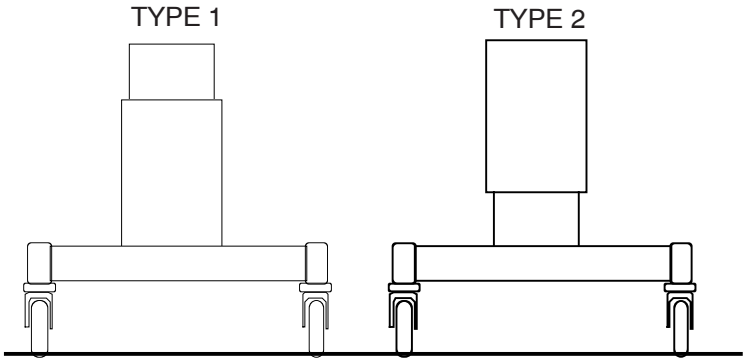


Figure 7-9
Infant Warmer Frame, IWS 3400, 4400 and 5000
(Type 2 unit shown)

7.10 Elevating Base Assembly - (5000/4400)

Type 1 Elevating column parts



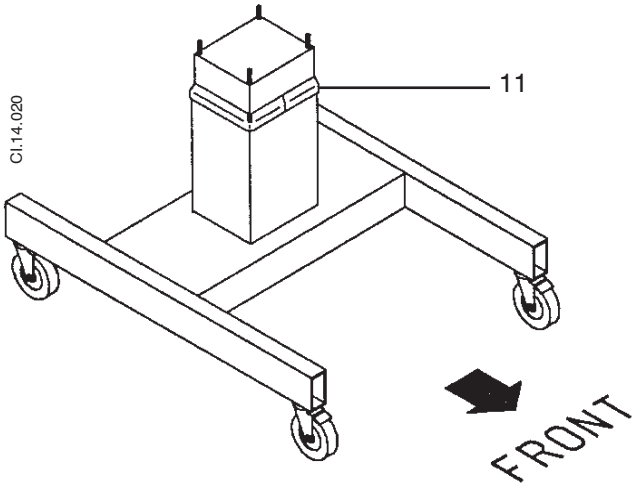
	Description	Stock Number
1.	Locking 5" Caster (black)	0215-8105-300
	Locking 5" Caster (grey)	6600-0569-400
2.	Locking nut	6600-0263-400
3.	Screw 5/16-18 x1	0144-2440-216
4.	Pyramidal lock washer	0202-3419-300
5.	Right leg (5000)	6600-0243-800
	Right leg (4400)	6600-0023-850
6.	Base Subassembly (includes items 13 through 16)*	
	120V (5000)	0217-5185-300
	220/230/240V (5000)	6600-0036-700
	100V (5000)	6600-0038-700
	120V (4400)	6600-0449-500
	220/230/240V (4400)	6600-0449-501
	100V (4400)	6600-0449-502
7.	Hole Plug	0203-0232-300
8	End Cap (5000)	0211-1549-300
	End Cap (4400) black	6600-0520-500
	End Cap (3400 & 4400) grey	6600-0520-501
9.	Non-Locking 5" Caster (black)	0215-8104-300
	Non-Locking 5" Caster (grey)	6600-0568-400
10.	Left leg (5000)	6600-0244-800
	Left leg (4400)	6600-0024-850
11.	Cover, elevating column	6600-0602-500
12.	Screw 5/16-18 x 1 hex	6600-0017-400
13.	Flexible Power Cord	6600-0033-700
14.	Gear/Jackshaft assembly (used in Type 1 units only)	0217-5175-300
15.	Capacitor 120V†	6600-0254-800
	Capacitor 220/230/240V†	6600-0255-800
	Capacitor 100V†	6600-0256-800
16.	Motor 115V	0208-2506-300
	Motor 220/230/240V	6600-0037-600
	Motor 100V 50/60 Hz	6600-0217-600

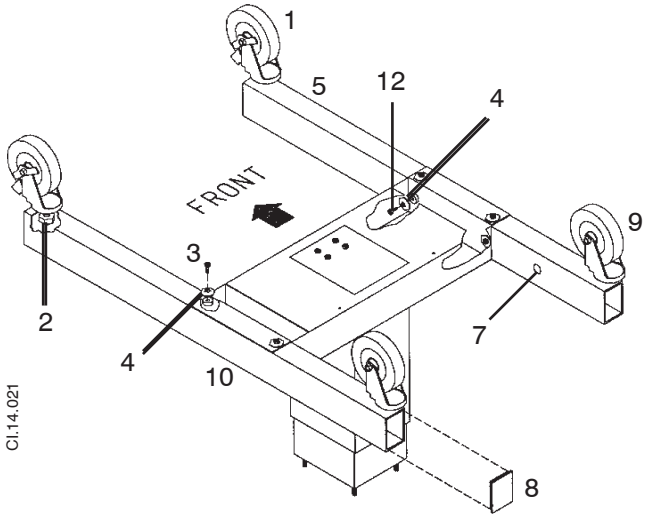
Parts not shown

Bearing replacement kit (Type 1 units - See Appendix)	6600-0069-850
Individual Bearing (8 required)	6600-0747-200

* Must order label set, see label section.

† Kit includes mounting bracket.





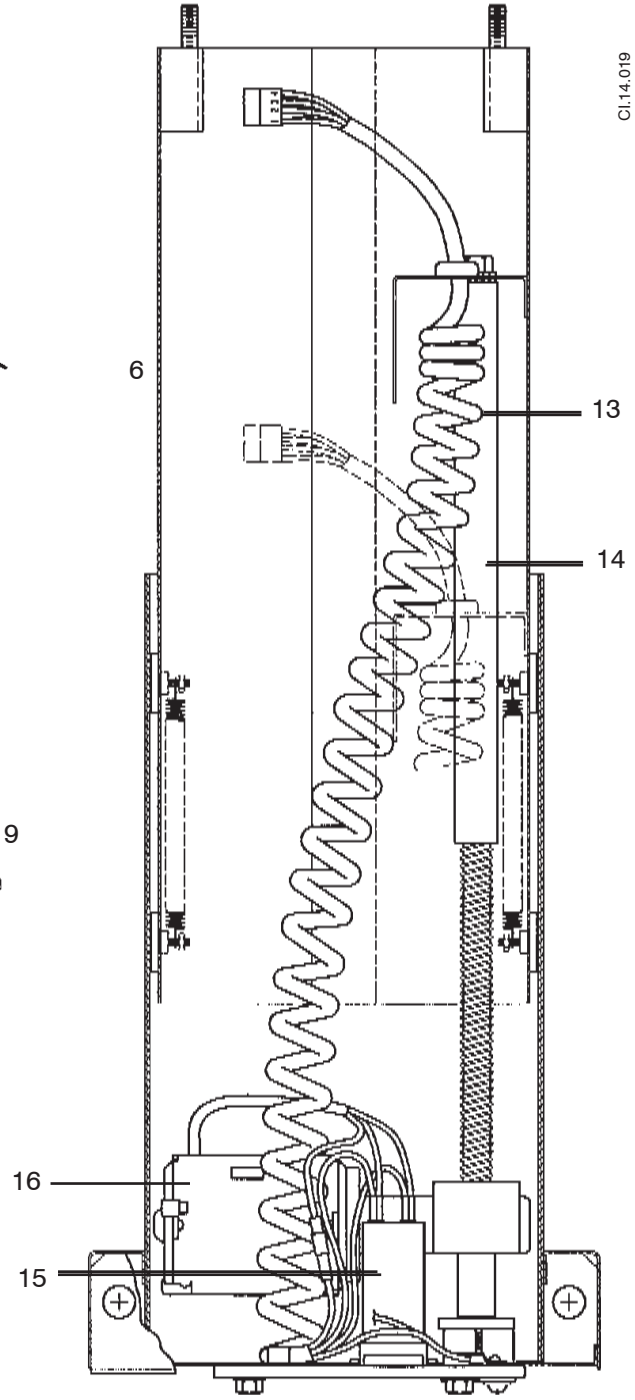
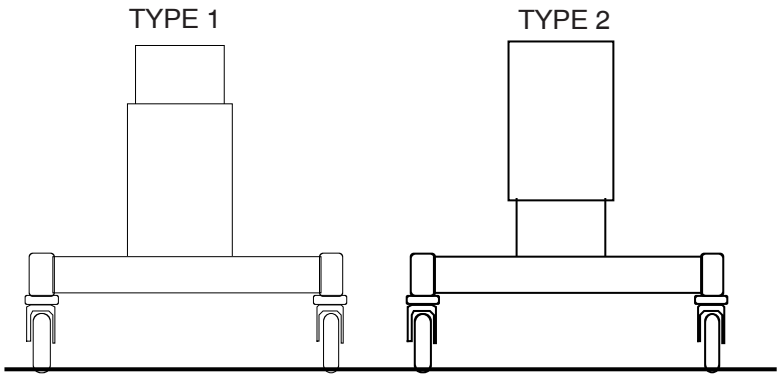


Figure 7-10
Type 1 Elevating Base Assembly, IWS 5000 and 4400

7.11 Column and base hardware-elevating units with footswitches

Type 2 Elevating column parts



	Description	Stock Number
1.	Lock washer, pryamidal 5/16	0202-3419-300
2.	Cap screw 5/16-18 x1	0144-2440-216
3.	Caster, non-locking	6600-0568-400
4.	Nut elastic 1/2-13	6600-0263-400
5.	Caster, locking	6600-0569-400
6.	Screw, 5/16-18 x 1 Hex Hd	6600-0017-400
7.	Lock washer, Int 5/16 x .029	0202-3418-300
8.	Nut, Hex 5/16-18	6600-0071-200
9.	Lock washer, Int #8 .328 OD	0202-3436-300
10	Screw, 8-32 x .38 Trs PH	6600-0261-400
11.	Cover plate	6600-0713-501
12.	End cover plate	6600-0714-501
13.	Nylon clip	6600-0609-400
14.	Nut #10 push-on	6600-0611-400
15.	Spring	6600-0612-400
16.	Slide	6600-0828-500
17.	Bearing, inner column	6600-0750-500
18.	Bushing	6600-0829-500
19.	Screw, 10-24 x 1 Flt Hd Skt	6600-0607-400
20.	Bearing disk (not present on units without holes)	6600-0830-500
21.	Nut, Hex 3/8-16	6600-0610-400
22.	Lock washer 3/8, split ring	6600-0440-400
23.	Outer column, grey†	6600-1514-500
24.	Inner column/base assembly†	6600-0712-501
25.	Label, name plate	6600-2004-101

† You must order both the inner and outer columns when you replace either. Also order items 14, 15, 16, 17, 18, 19, and 25 plus footswitches on page 7-22.

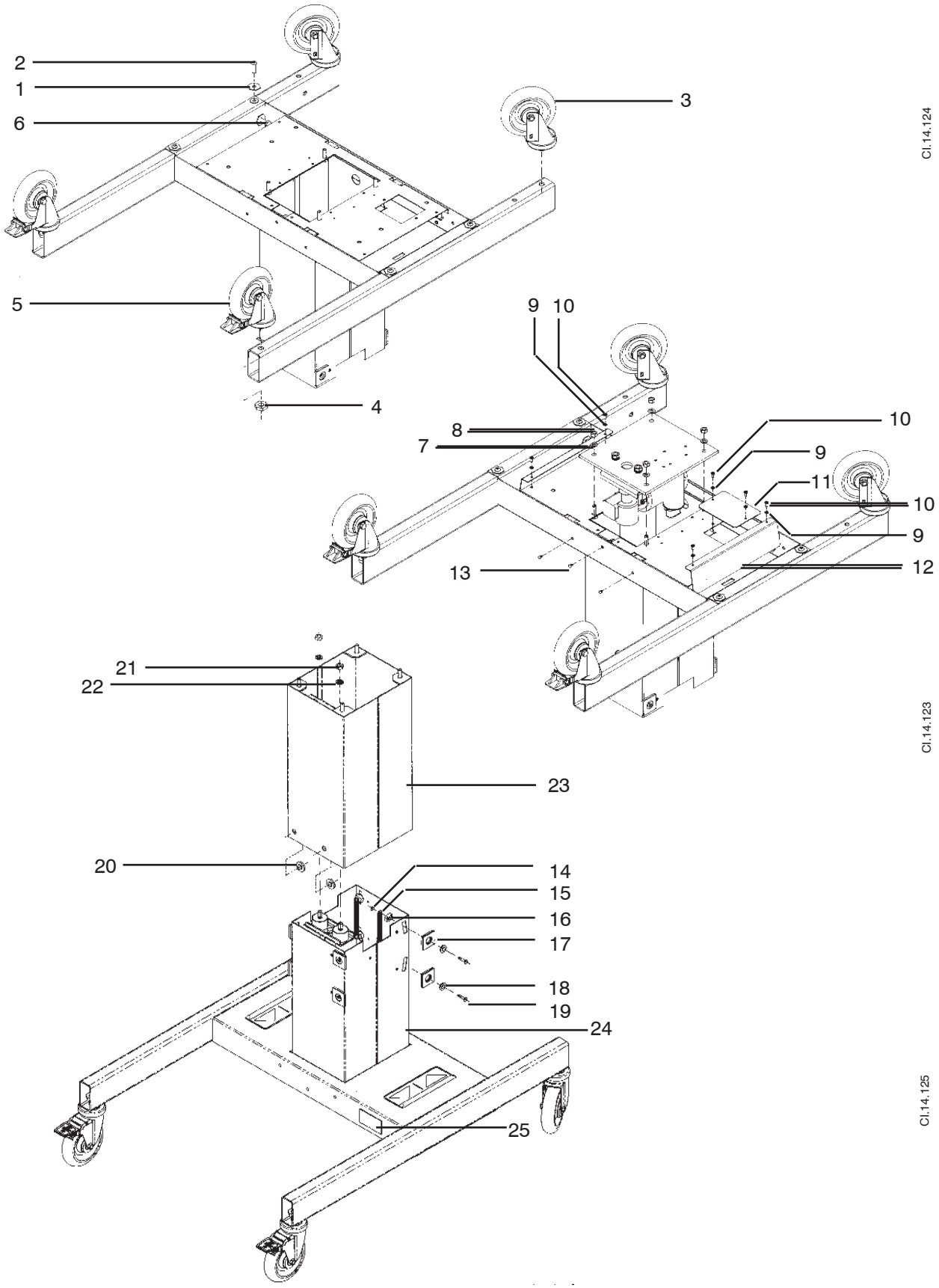
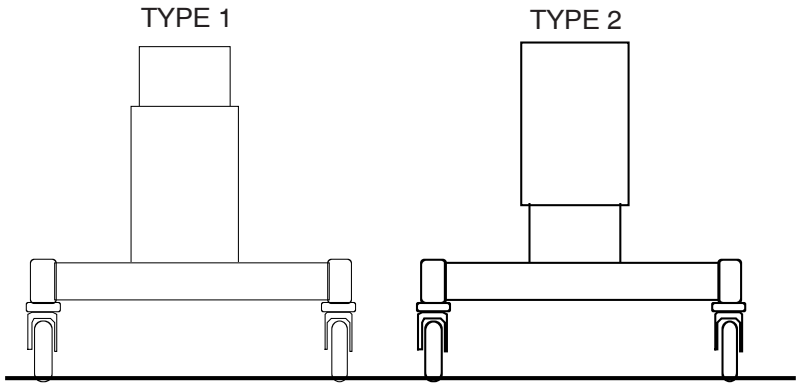


Figure 7-11
Type 2 Column and base hardware-elevating units with and without footswitches

7.12 Inner column footswitch components



	Description	Stock Number
1.	Screw, 5/16 - 18 x 1 Hex	6600-0017-400
2.	Spring lock washer, 5/16	6600-0608-400
3.	Compression mount	6600-0565-400
4.	Mounting plate	6600-0748-500
5.	Actuator column	6600-0294-400
6.	Motor, 115V	6600-0465-600
	Motor, 220-240V	6600-0466-600
	Motor, 100V 50/60 Hz	6600-0464-600
7.	Spacer	6600-0710-500
8.	Screw, 5/16 -18 x 2 Hex	6600-0556-400
9.	Rubber boot	6600-0836-500
10.	Capacitor 120V 40 MFD	6600-0480-600
	Capacitor 220-240V 10 MFD*	6600-0479-600
	Capacitor 100V 45 MFD	6600-0481-600
11.	Nut, 8 -32 Keps	0202-1131-300
12.	Cable clamp	6600-0631-400
13.	Mounting ring	6600-0334-400
14.	Lock washer, 3/8 split ring	6600-0440-400
15.	Nut, 3/8 -16 Hex	6600-0610-400
16.	Actuator mounting plate	6600-0749-500
17.	Coiled cord assembly	6600-0033-700
18.	Strain relief bushing	6600-0558-400
19.	Column cable	6600-0481-700
20.	Cable clamp 3/16"	6600-0051-600
21.	Nut, keps 3-32 x .34	0202-1131-300
22.	Footswitch guide bar	6600-0843-500
23.	Ground label	0205-4737-300
24.	Connector retainer	6600-0572-600
25.	Footswitch kit (includes footswitch and 2 of item 24)	6600-0061-850
26.	Nameplate Label	6600-2004-100

* On some 220-240V elevating IWS units an alternate motor run capacitor has been installed at the factory. This capacitor has an oval shape, rather than the round shape capacitor shown. When replacing the oval shape capacitor, a round mounting bracket (item 13) and hardware (3 of item 11) will be required to accommodate the round shape capacitor.

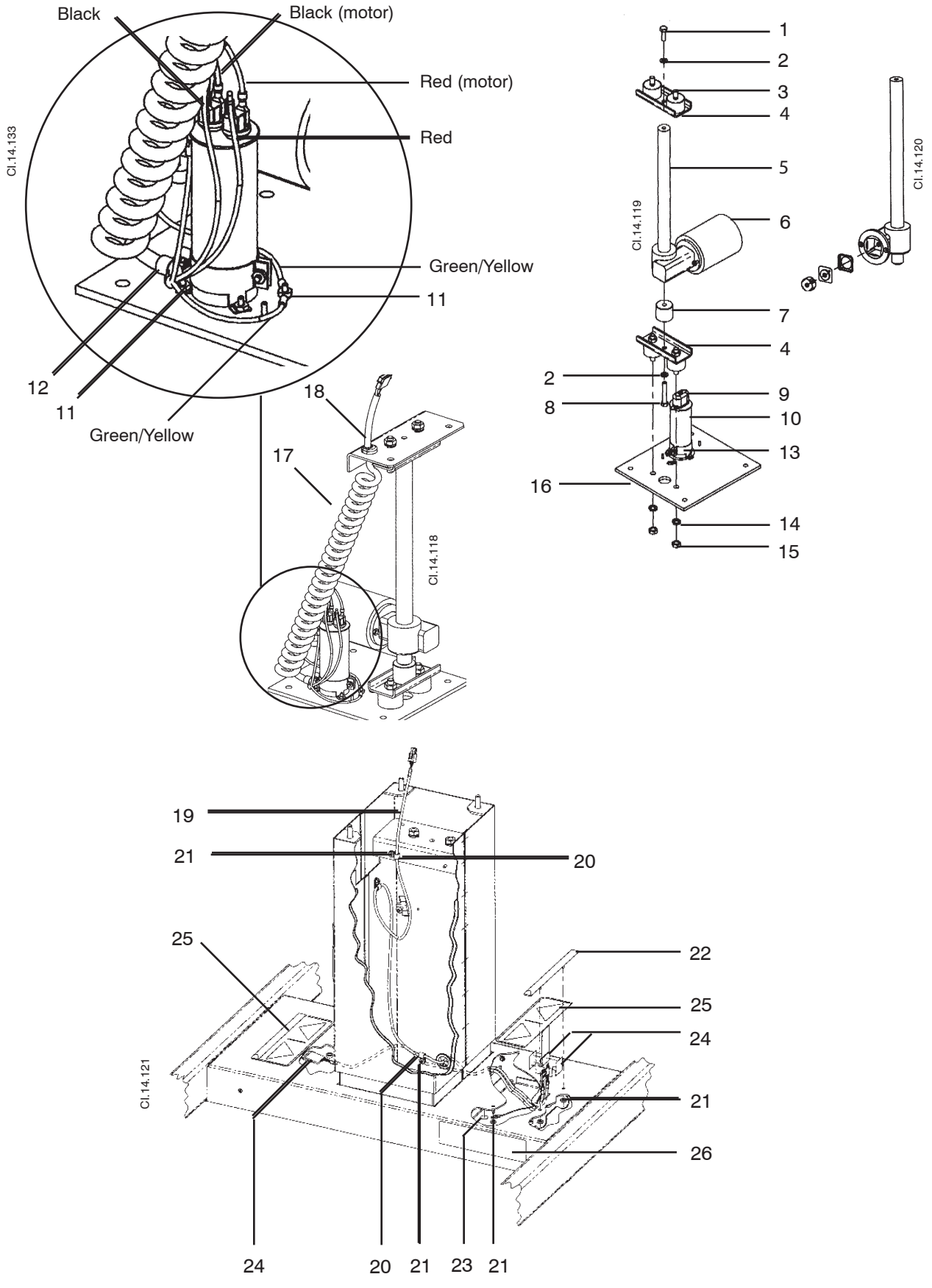


Figure 7-12
Type 2 Inner column footswitch components

7.13 Model 3500 frame assembly

	Description	Stock Number
1.	3500 Upper cross member assy. (beige)	6600-0341-702
	3500 Upper cross member assy. (light grey)	6600-0341-705
2.	Screw	0142-1874-510
3.	Cover	0214-1550-549
4.	Lock washer, #8 int	6600-0262-400
5.	Screw, 8-32 x 3/8	6600-0261-400
6.	End cap (black)	6600-0302-500
	End cap (grey)	6600-0703-501
7.	Routing Clip (Pkg 6) - grey	6600-0055-851
8.	Screw, #8-32, 5/8" *	0140-6627-110
9.	Caster, 2.50, with Lock	6600-0184-400
10.	Lock Washer, #8, external	6600-0379-400
11.	Caster, 2.50	6600-0183-400
12.	Base (beige)	6600-0189-400
	Base (light grey)	6600-0189-401
13.	Nut, elastic 1/2 - 13†	6600-0263-400
14.	Washer, .5621 x 1, .25 OD	0202-4138-300
15.	Tierod 1/2 - 13 x6	0217-5284-300
16.	Nut, elastic 5/16 -24^	0202-1017-300
17.	Washer, .344 ID, .875 OD	6600-0290-400
18.	Screw, 5/16 - 24 x 2-3/4	0144-2241-244
19.	Bar upright	6600-0301-500
20.	Dovetail upright	6600-0180-400
21.	Modesty panel (light grey)	6600-0300-501
	Modesty panel (beige)	6600-0300-500
22.	Lower cross, 3500 (beige)	6600-0177-400
	Lower cross, 3500 (light grey)	6600-0177-401

*Torque 35 in lb. ± 5 in. lb.

†Torque 105 in lb. ± 5 in. lb.

^Torque 360 in lb. ± 5 in. lb.

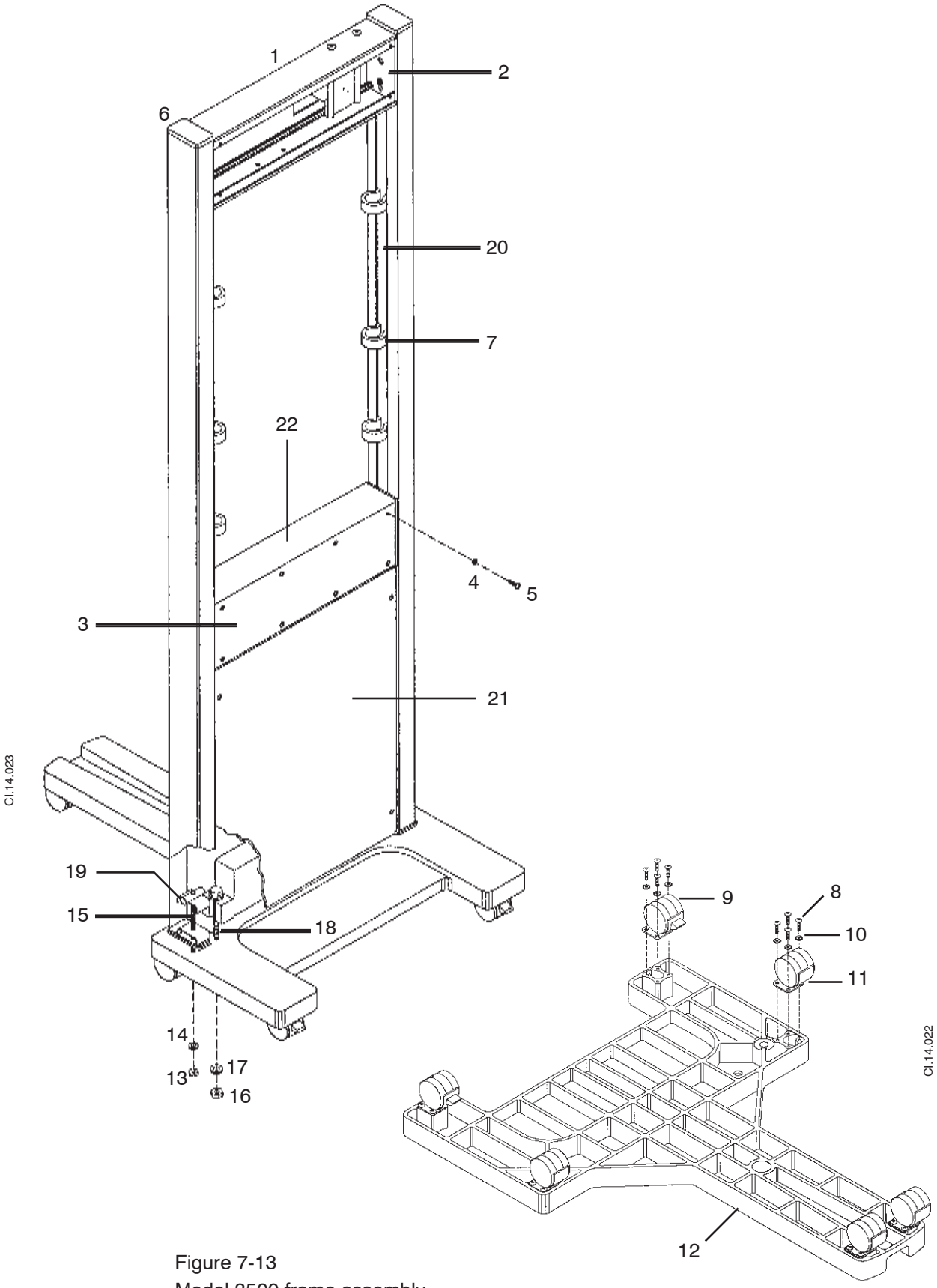
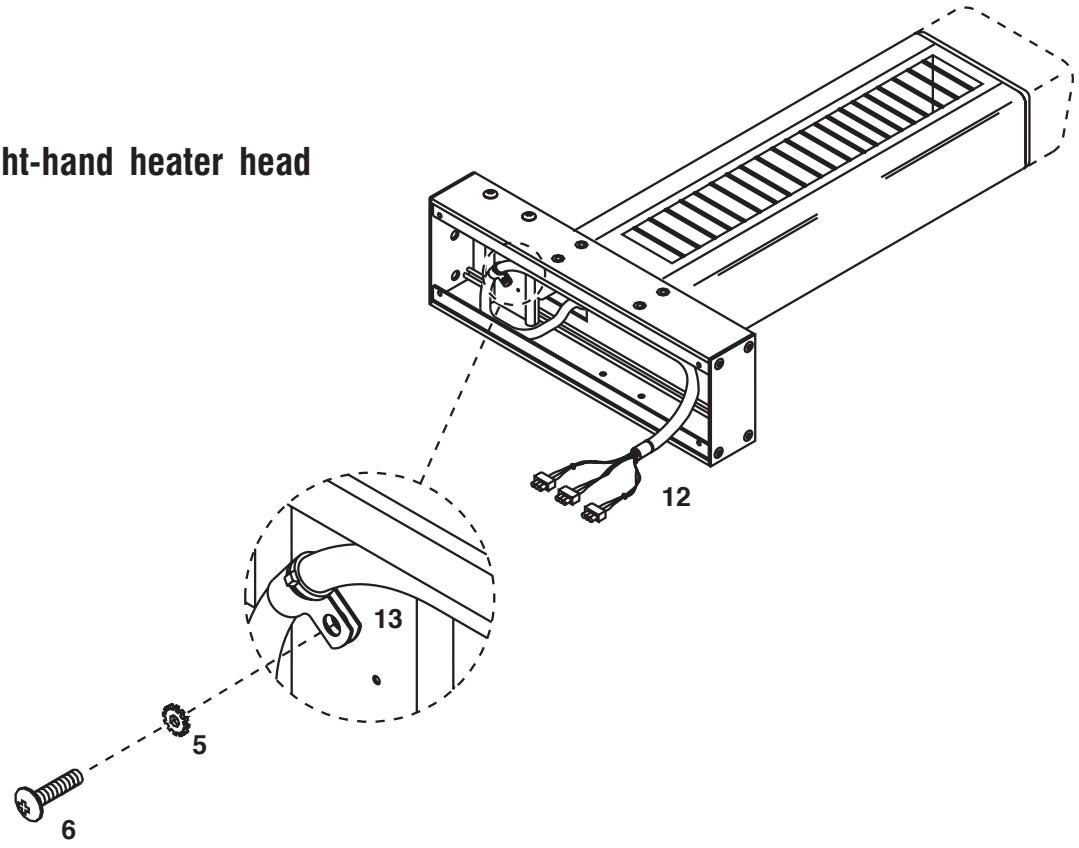


Figure 7-13
Model 3500 frame assembly

7.14 Heater Connections

Right-hand heater head



CI.14.197

	Description	Stock Number
1.	Wire Harness, elevating base interconnect	6600-0085-700
2.	Interconnect Wire Harness	
	Units with AAN, HAJ and HAK serial numbers	0208-6179-700
	Units with HCA and HCC serial numbers (left-hand units)	6600-0334-700
3.	Cable Tie (left-hand only)	0203-5919-300
4.	Interlock Switch Bracket	0214-1570-500
5.	External Lock Washer #8	6600-0379-400
6.	Screw 8-32 x 3/8	6600-0261-400
7.	Lock washer, internal #8	6600-0262-400
8.	Power Cord	
	100/120V 60 Hz	0208-0950-300
	240 V 50 Hz (Australian)	6600-0574-604
	220/230/240V 50/60 Hz	6600-0574-602
9.	Bracket, plug guard	6600-0572-500
10.	Controller cover (Model 2001, Series 3000 and Series 4000)*	0214-1564-549
	Controller cover (Model 5000)†	0214-2273-549
11.	Screw 8-32 x .50	0140-6627-108
12.	Wire Harness, right-hand units	6600-0590-700
13.	P-Clip	6600-0871-500

*Order label 0205-4958-300 when replacing cover.

†Order label 6600-1988-101 when replacing cover.

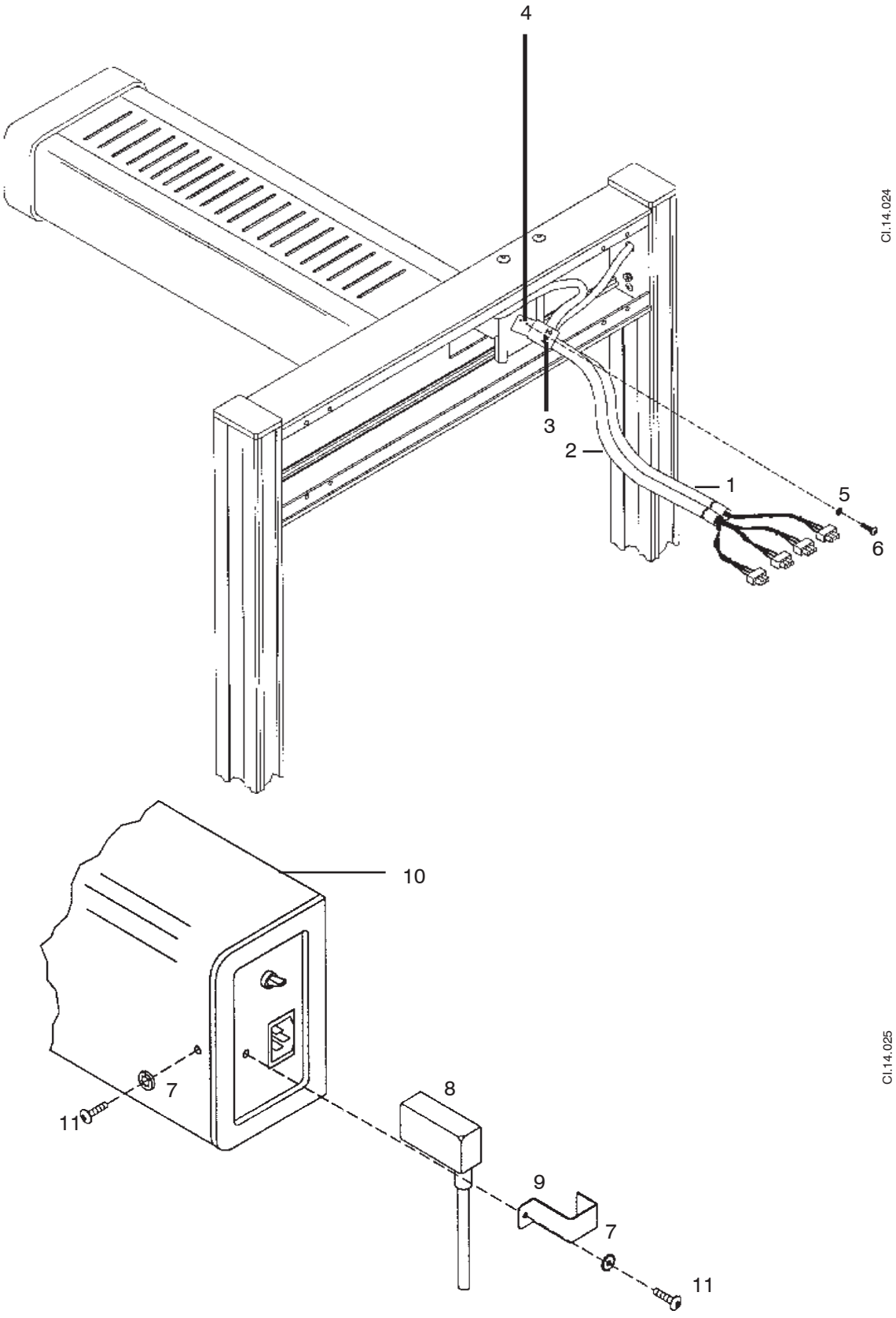


Figure 7-14
Heater Connections

7.15 Heater Assembly

	Description	Stock Number
1.	Screw 6-32 x 3/8	0400-1093-300
2	Screw 6-32 x 1-l/8	6600-0214-400
3.	Alarm Lens	0217-5305-100
4.	Incandescent Lamp 120V	0690-2100-315
5.	Front End Cap (beige)	0217-5303-100
	Front End Cap (grey)	6600-0884-501
6.	Warmer Module Side	
	Model 2001, 3000, 3300 (beige)	0217-5304-510
	Model 2001 and series 3000, (light grey)	6600-0835-501
	Model 3500 (beige)	6600-0179-400
	Model 3500 (light grey)	6600-0179-401
	Model 5000,4000,4300,4400 (beige)	0217-5181-510
	Model 5000, 4000, 4300, 4400 (light grey)	6600-0797-501
7.	Rear End Cap (beige)	0217-5319-210
	Rear End Cap (light grey)	6600-0815-501
8.	Screw 1/4-20 Hex Head	0142-9277-132
9.	Bumper	0211-1657-300
10.	Heater assy. without heater tube holders (does not include heater tube)	
	Model 2001, Series 3000 with HAK,HAJ & AAN serial number	6600-0316-700
	Model 2001, Series 3000 with HCA and HCC serial number	6600-0316-701
	Model 5000 with AAN serial number	6600-0316-706
	Model 5000, Series 4000 with HCA and HCC serial number	6600-0316-702
11.	Ventilation Plate (2001, Series 3000), beige	0214-1556-510
	Ventilation Plate (2001, Series 3000), grey	6600-0804-501
	Ventilation Plate (5000, Series 4000), beige	6600-0030-500
	Ventilation Plate (Series 4000), grey	6600-0030-501
12.	Lock Washer	0202 3415-300
13.	Hinge Pin	0217-5215-500
14.	Screw 1/4.-20 x 3/4	6600-0395-400
15.	Hinge Cover (beige)	6600-0475-500
	Hinge Cover (grey)	6600-0475-501
16.	Screw 8-32 x 3/8	6600-0261-400
17.	Internal Lock Washer #8	6600-0262-400
18.	External Lock Washer #8	6600-0379-400
19.	Bulb Access Cover (beige)	6600-0476-500
	Bulb Access Cover (grey)	6600-0476-501
20.	Ground Label	0205-4737-300
21.	Insert, Wood Trim, Oak, Model 3500 only	6600-0298-500
22.	Instruction Label Plate -	
	Units with HAK, HAJ, AAN & HCA serial number	0214-1568-500
23.	Instruction Label (applied to item 22) Units with HAK, HAJ, AAN & HCA serial number)	
	English	0205-4958-300
	French	6600-0089-100
	Spanish	6600-0460-100
	German	6600-0470-100
	Italian	6600-1565-100
	Swedish	6600-1567-100
24.	Soft Front End Cap, light grey - Units with HCC serial number	6600-0841-500
	Label, Logo	See label section
25.	Screw, 1/4 -20 x 1 Hex	6600-0630-400
26.	End cap support plate - Units with HCC serial number	6600-0839-500
27.	P-clip	6600-0871-500

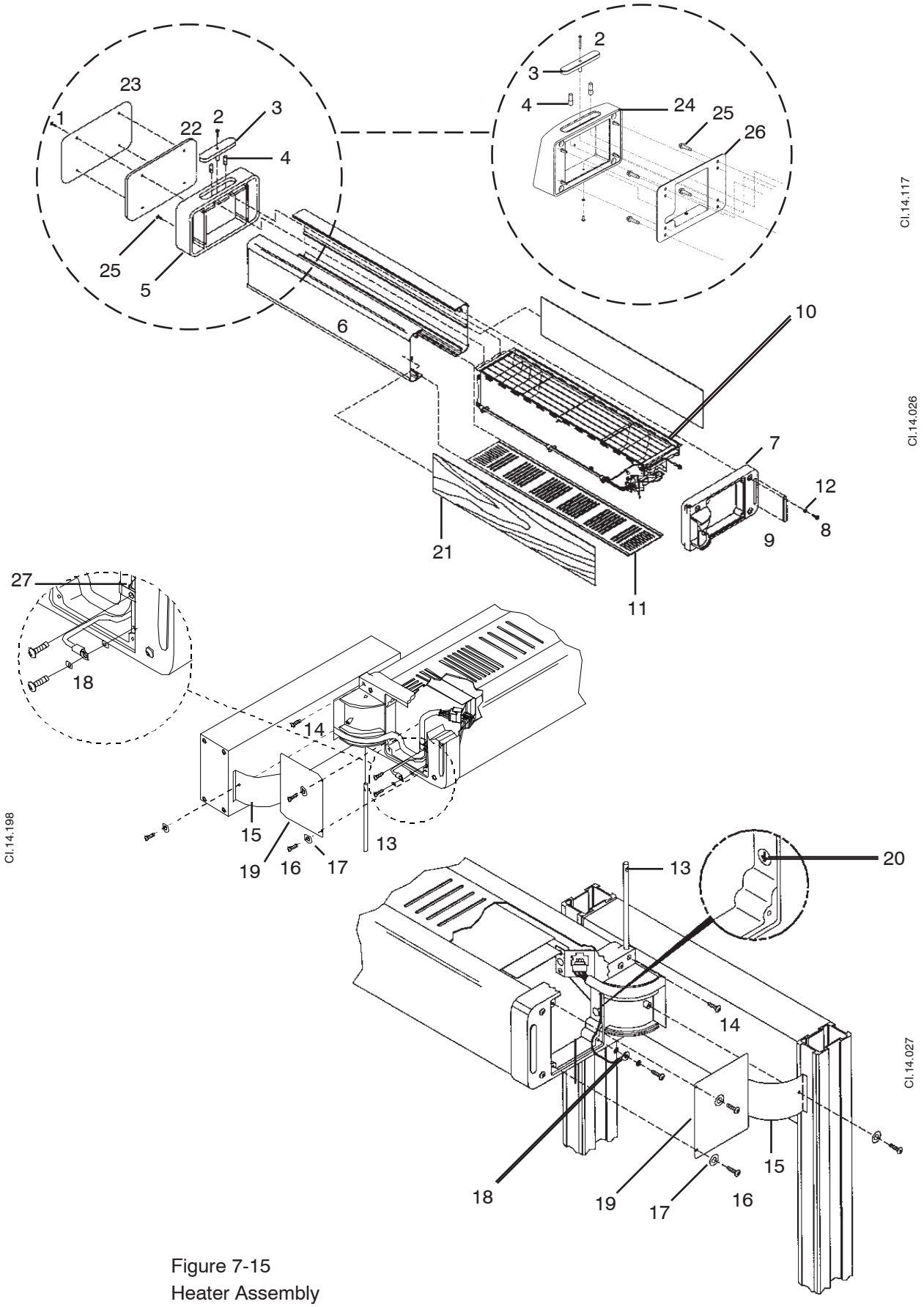
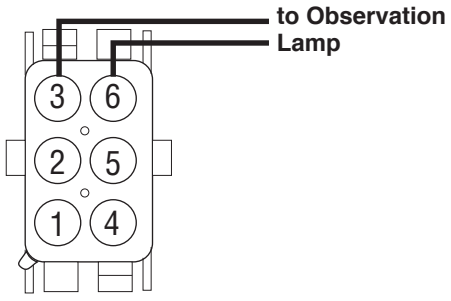
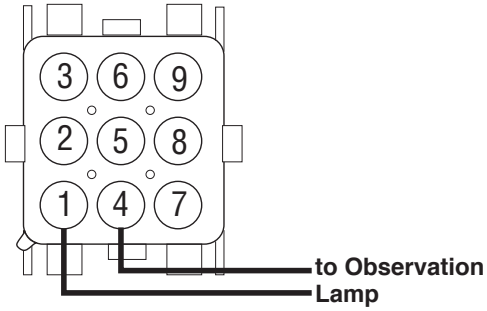


Figure 7-15
Heater Assembly

7.16 Infant Warmer Heater Wiring

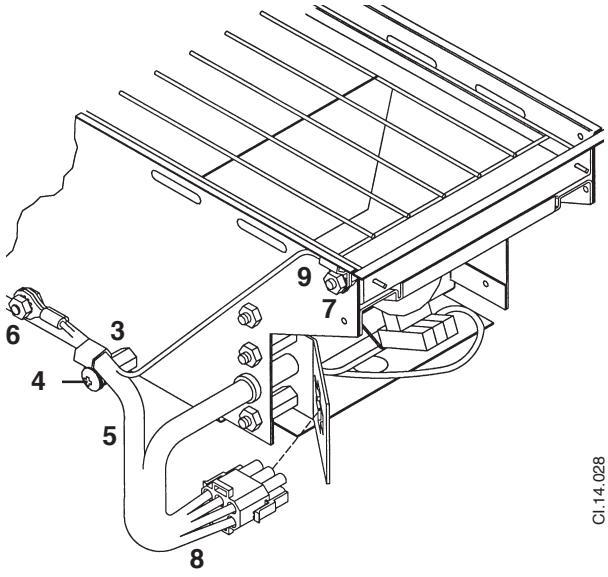


**Top View
Plug Diagram
(Item 8)
Units without HCA serial numbers**



**Top View
Plug Diagram
(Item 8)
Units with HCA or HCC
serial numbers**

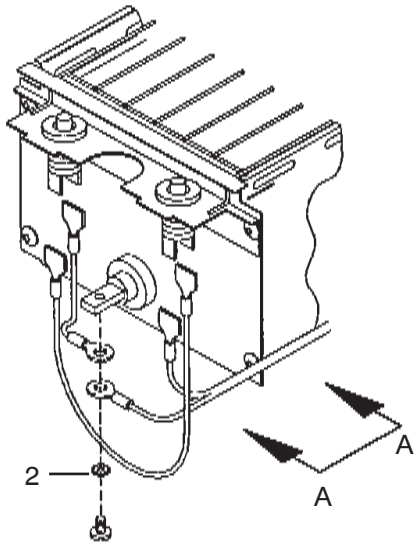
Cl.14.091



Cl.14.028

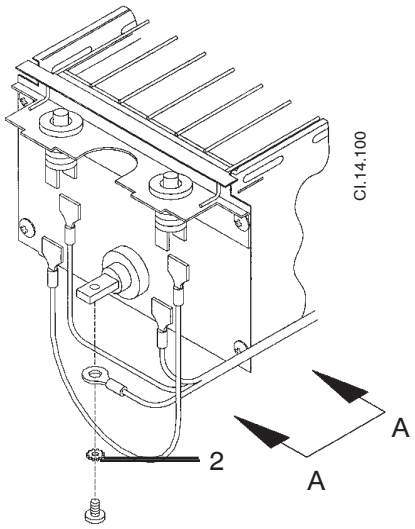
	Description	Stock Number
1.	Connector Adapter, Faston	0208-0511-300
2.	External Lock Washer #10	0202-3210-340
3.	Cable Clamp, Nylon Type n-2	0208-0446-300
4.	Lock washer Ext-6	6600-0259-400
5.	Screw 6-32 x 3-8	0140-6624-106
6.	Nut, 8-32 w/External Lock washer	0202-1131-300
7.	Nut, 6-32 w/External Lock Washer	6600-0382-400
8.	Lamphouse Wiring Harness	
	Model 2001, Series 3000 with HAK or AAN serial number	0208-6180-700
	Model 5000 with AAN serial number	6600-0005-700
	Model 2001, Series 3000 with HCA or HCC serial number	6600-0343-700
	Model 5000, Series 4000 with HCA or HCC serial number	6600-0335-700
9.	Cable Clamp	0208-0331-300

Units with HAK, HAJ or AAN serial number



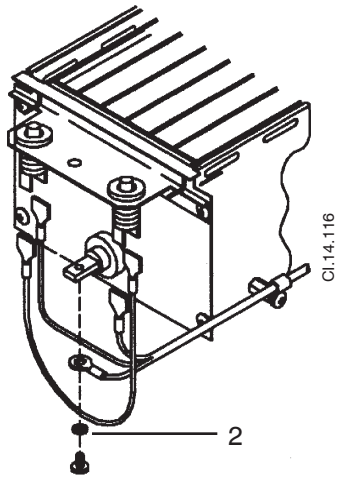
220/240V
Wiring Configuration

Units with HCA serial number

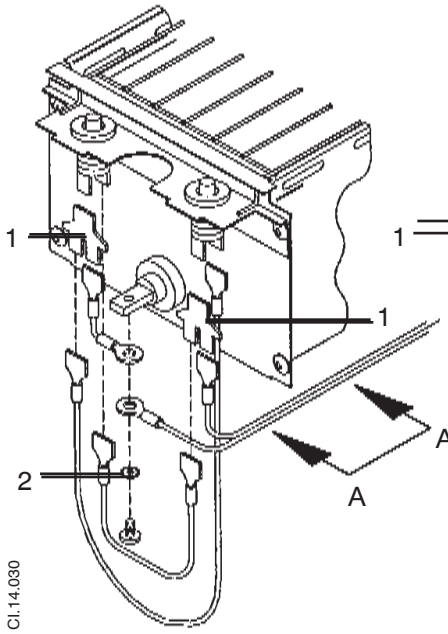


220/230/240V
Wiring Configuration

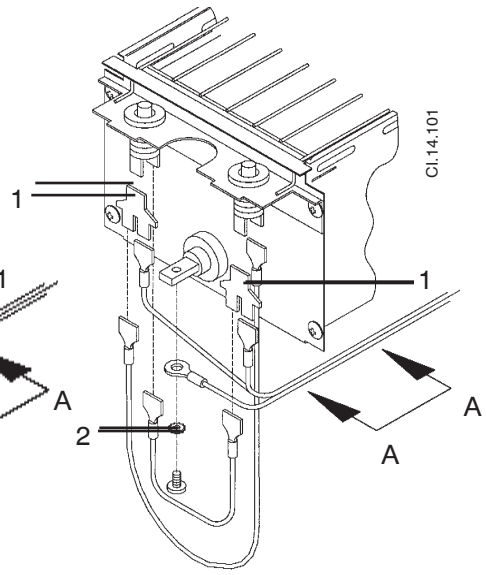
Units with HCC serial number



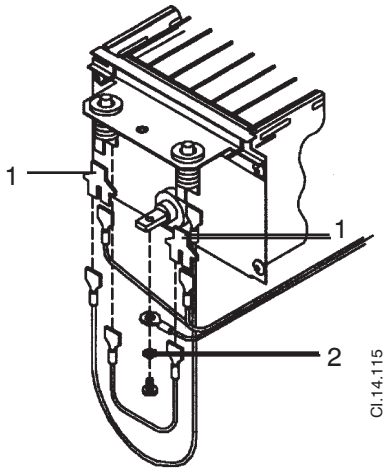
220/230/240V
Wiring Configuration



100/120V
Wiring Configuration



100/120V
Wiring Configuration



100/120V
Wiring Configuration

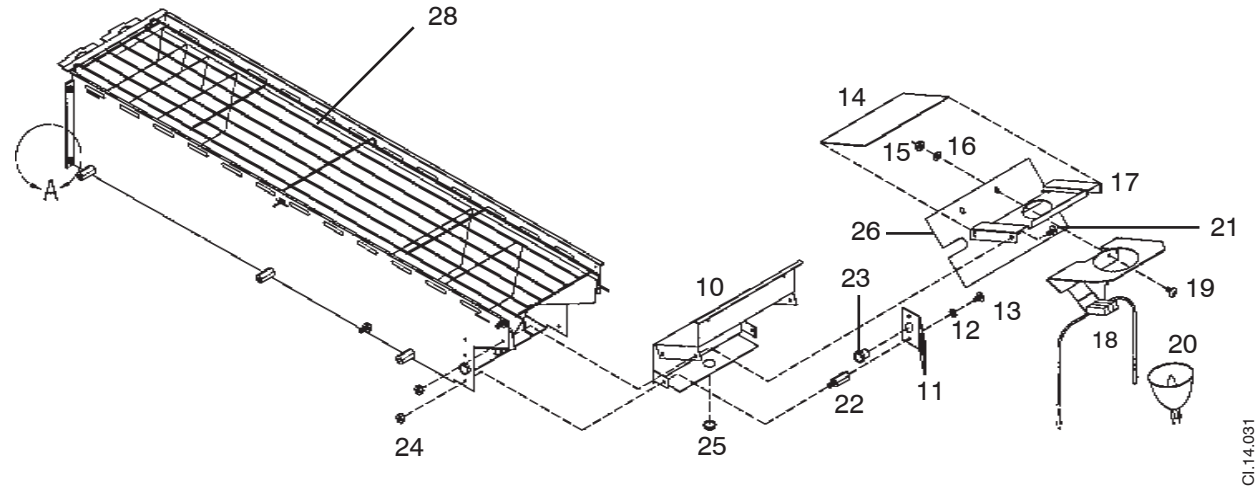
View A-A shown on page 7-33

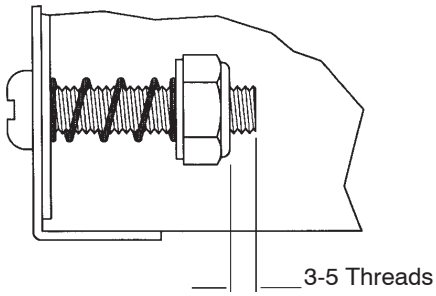
Figure 7-16
Infant Warmer Heater Wiring

7.17 Infant Warmer Assembly

	Description	Stock Number
1.	Screw 6-32 x 1/2	0140-6124-108
2.	Lamp Socket Sylvania #31099	0686-9000-416
	Lamp GTE Sylvania 120MB 6W	0690-2100-315
3.	Alarm Light Bracket -	
	units with HAK, AAN or HCA serial number	0214-1567-500
	Alarm Light Bracket - unit with HCC serial number	6600-0842-500
4	Front Reflector End Cap	0217-5213-500
5.	Heater Tube	
	120V 440W (2001/series 3000 with HAK, HAJ or AAN)	6600-0284-800
	220V 440W (2001/series 3000 with HAK, HAJ or AAN)	6600-0285-800
	230/240V 440W (2001/series 3000 with HAK, HAJ or AAN)	6600-0286-800
	100V 440W (2001/series 3000 with HAK, HAJ or AAN)	6600-0287-800
	120V 540W (5000/series 4000)	6600-0280-800
	220V 540W (5000/series 4000)	6600-0281-800
	240V 540W (5000/series 4000)	6600-0282-800
	100V 540W (5000/series 4000)	6600-0283-800
	120V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0014-850
	220V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0015-850
	230/240V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0016-850
	100V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0017-850
6.	Nut, #6-32 w/Ext Lock washer	6600-0382-400
7.	Washer	6600-0378-400
8.	Spring	6600-0019-300
9.	Nut	6600-0111-400
10.	Rear Reflector Cap	0217-5212-500
11.	Wire Harness Socket Bracket	0214-1566-500
12.	External lock washer #6	6600-0259-400
13.	Screw, 6-32 x 1/4	6600-0389-400
14.	Exam Light Lens 3 x 5	0217-5306-300
15.	Nut, Keps 4-40	6600-0073-400
16.	Washer #4	6600-0358-400
17.	Lamp holder Bracket	0217-5214-500
18.	Lamp holder kit	
	Units with AAN, HAJ, or HAK serial numbers (sockets)	6600-0010-850
	Units with HCA or HCC serial numbers (pins)	6600-0011-850
19.	Screw, 4-40 x 5/16	6600-0388-400
20.	Lamp 12V 50W GE EXZ(Q50 MR16/NFL)	
	or GE EXN(Q50 MR16/FL)	0208-0516-300
21.	Screw, 6-32 x 1/2	0140-6124-108
22.	Spacer 1/4" Hex 6-32 .75L	0402-0234-300
23.	Snap Bushing 3/8 I.D. for .50 Hole	6600-0519-500
24.	Nut, #6-32 w/Ext Lock washer	6600-0382-400
25.	Hole Plug	6600-0392-400
26.	Insulator Fishpaper	6600-0002-300
27.	Screw 6-32 x 7/8	0140-6124-114
28.	Heater grille, series 3000	6600-0027-500
	Heater grille, series 4000	6600-0007-700

* These tubes are designed for newer units (with HCA and HCC serial number) that have 540 watts heaters. Placing these tubes in older 440 watts unit will cause equipment damage.





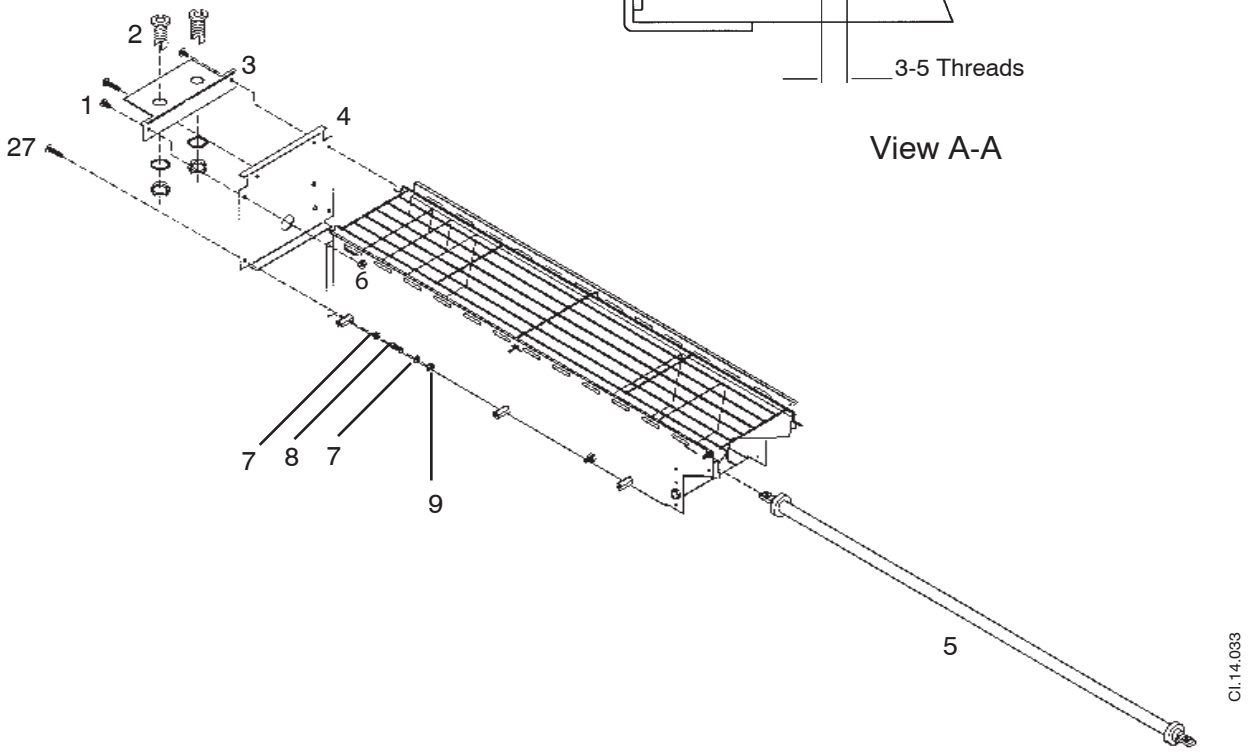
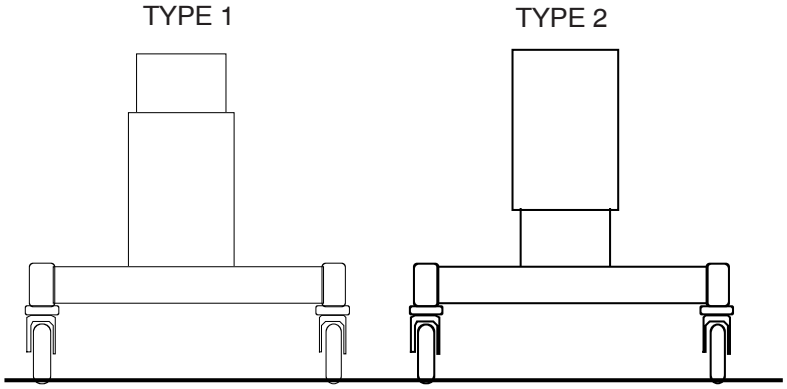


Figure 7-17
Infant Warmer Assembly

7.18 Bed Assembly



	Description	Stock Number
1.	Elastic Nut 5/16-24	0202-1017-300
2.	Screw 10-24 x 3/8	6600-0250-400
3.	Lock washer #10	0144-1110-131
4	Tubing Cover Plate, small bed - series 3000	0214-2268-511
	Tubing Cover Plate, large bed - series 4000	6600-1035-500
5.	Tilt Plate Cover (light grey) small bed - series 3000	6600-0807-501
	Tilt Plate Cover (light grey) large bed - series 4000	6600-1061-500
6.	Tubing Actuator Rod	0217-5323-500
7.	Extension Spring	6600-0013-300
8.	Bed Tilt Lever (black)	0217-5277-100
	Bed Tilt Lever (grey)	6600-0800-501
9	Pin	0217-5321-500
10	Hydraulic System Assembly (includes item 11)	6600-0325-800
	Rubber boot (not shown)	0217-5259-100
11.	Ball Joint	0217-5318-300
12.	Valve Bed Hydraulic Plate	0217-5283-100
13.	Bed (Series 3000, except 3500) - light grey	6600-0814-501
	Bed (Series 4000) - light grey	6600-0818-501
	Bed (Series 3000, except 3500) - beige	0217-5316-100
	Bed (Series 4000 & 5000) - beige	0217-5381-100
14.	Pin	0217-5322-500
15.	Pivot Rod	0217-5312-549
16.	Corner Block- grey (pkg 4 - includes items 2, 19, 22 & 23)	6600-0228-801
	Corner Block- black (pkg 4 - includes items 2, 19, 22 & 23)	6600-0228-800
17.	Rod	0217-5313-300
18.	Hook	0203-5194-300
19.	O-ring	6600-0348-400
20.	Bed support (beige) except type 2 elevating units	0217-5310-210
21.	Bed support - Type 2 elevating units (beige)	6600-0717-502
	Bed support - Units with HCC serial number only (light grey)	6600-0717-501
22.	Bearing	0209-0079-300
23.	Split ring lock washer, #10	6600-0322-400
24.	Washer, flat	0202-4518-340

Parts not shown

	Replacement Bed Assembly (includes items 1 - 24)	0217-5385-810

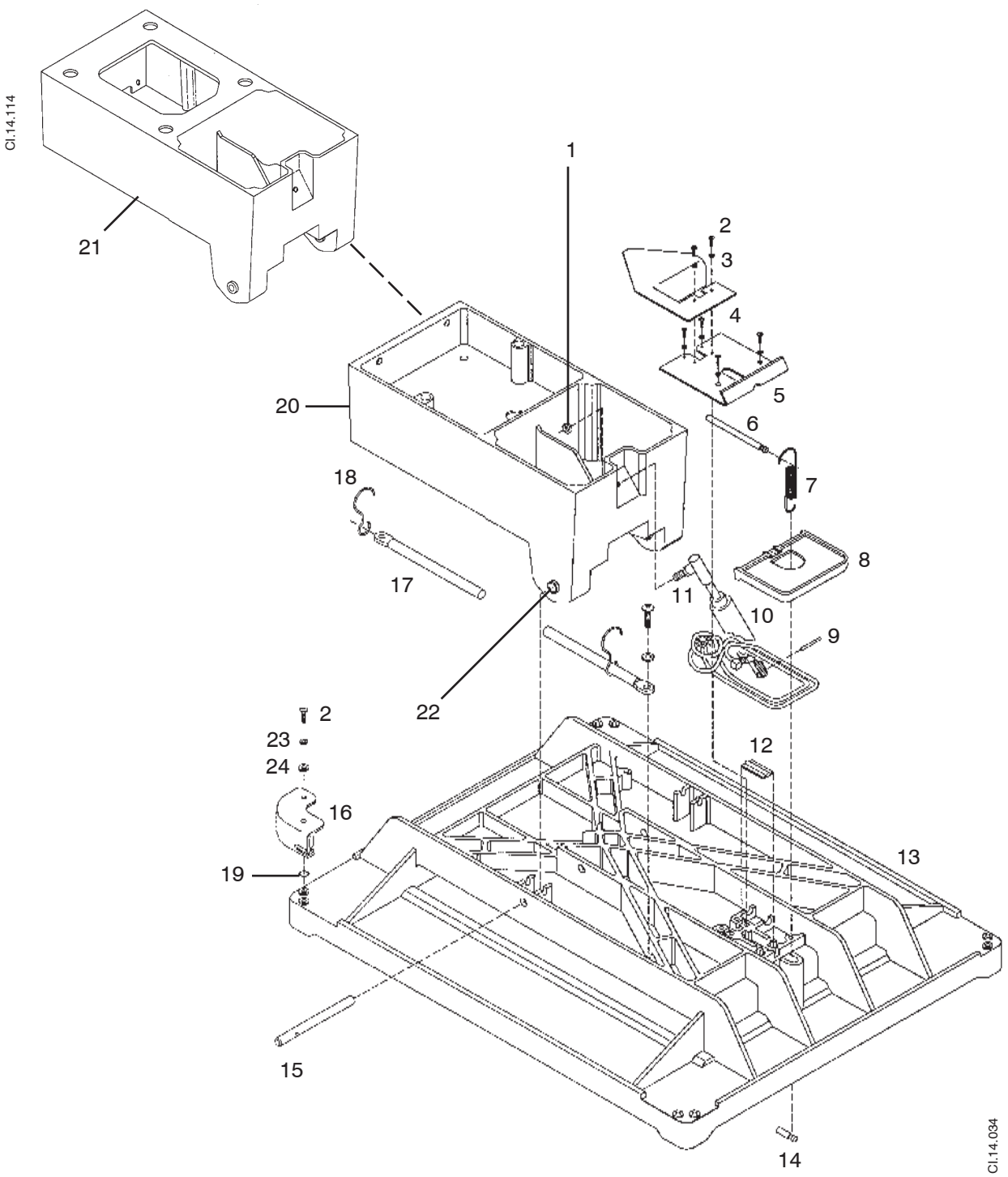


Figure 7-18
Bed Assembly

7.19 Wood Accent Parts

Determine the wood shade by the last three digits of the part number on the unit:

900 = natural oak	901 = bleached oak	902 = medium oak
903 = dark oak	904 = cherry maple	905 = natural maple
906 = bleached maple	907 = special stain, contact service support	

Description	Stock Number
1. Wood Heater Head Insert	
Series 3000 (short), Natural Oak	6600-1025-501
Series 3000 (short), Bleached Oak	6600-1025-502
Series 3000 (short), Medium Oak	6600-1025-503
Series 3000 (short), Dark Oak	6600-1025-504
Series 3000 (short), Cherry Maple	6600-1025-505
Series 3000 (short), Natural Maple	6600-1025-506
Series 3000 (short), Bleached Maple	6600-1025-507
Series 4000 (long), Natural Oak	6600-1026-501
Series 4000 (long), Bleached Oak	6600-1026-502
Series 4000 (long), Medium Oak	6600-1026-503
Series 4000 (long), Dark Oak	6600-1026-504
Series 4000 (long), Cherry Maple	6600-1026-505
Series 4000 (long), Natural Maple	6600-1026-506
Series 4000 (long), Bleached Maple	6600-1026-507
2. Wood Upright Insert	
Model 3300 & 4300, Natural Oak	6600-1030-501
Model 3300 & 4300, Bleached Oak	6600-1030-502
Model 3300 & 4300, Medium Oak	6600-1030-503
Model 3300 & 4300, Dark Oak	6600-1030-504
Model 3300 & 4300, Cherry Maple	6600-1030-505
Model 3300 & 4300, Natural Maple	6600-1030-506
Model 3300 & 4300, Bleached Maple	6600-1030-507
Model 3400 & 4400 (elevating), Natural Oak	6600-1031-501
Model 3400 & 4400 (elevating), Bleached Oak	6600-1031-502
Model 3400 & 4400 (elevating), Medium Oak	6600-1031-503
Model 3400 & 4400 (elevating), Dark Oak	6600-1031-504
Model 3400 & 4400 (elevating), Cherry Maple	6600-1031-505
Model 3400 & 4400 (elevating), Natural Maple	6600-1031-506
Model 3400 & 4400 (elevating), Bleached Maple	6600-1031-507
3. Standard Wood Drawer Package Assembly	
(fits all Series 3000, small bed, & 4000, large bed, and rotating drawer units)	
Natural Oak	6600-0612-801
Bleached Oak	6600-0612-802
Medium Oak	6600-0612-803
Dark Oak	6600-0612-804
Cherry Maple	6600-0612-805
Natural Maple	6600-0612-806
Bleached Maple	6600-0612-807
Pass through Wood Drawer Package Assembly	
(fits Series 3000 small bed units)	
Natural Oak	6600-0626-801
Bleached Oak	6600-0626-802
Medium Oak	6600-0626-803
Dark Oak	6600-0626-804
Cherry Maple	6600-0626-805
Natural Maple	6600-0626-806
Bleached Maple	6600-0626-807
Parts not shown	
Slides for standard wooden drawers(2 slides, left or right)	6600-0779-206
Slides for pass through wooden drawers(2 slides, left or right)	6600-0779-207
Drawer lock	6600-0779-201

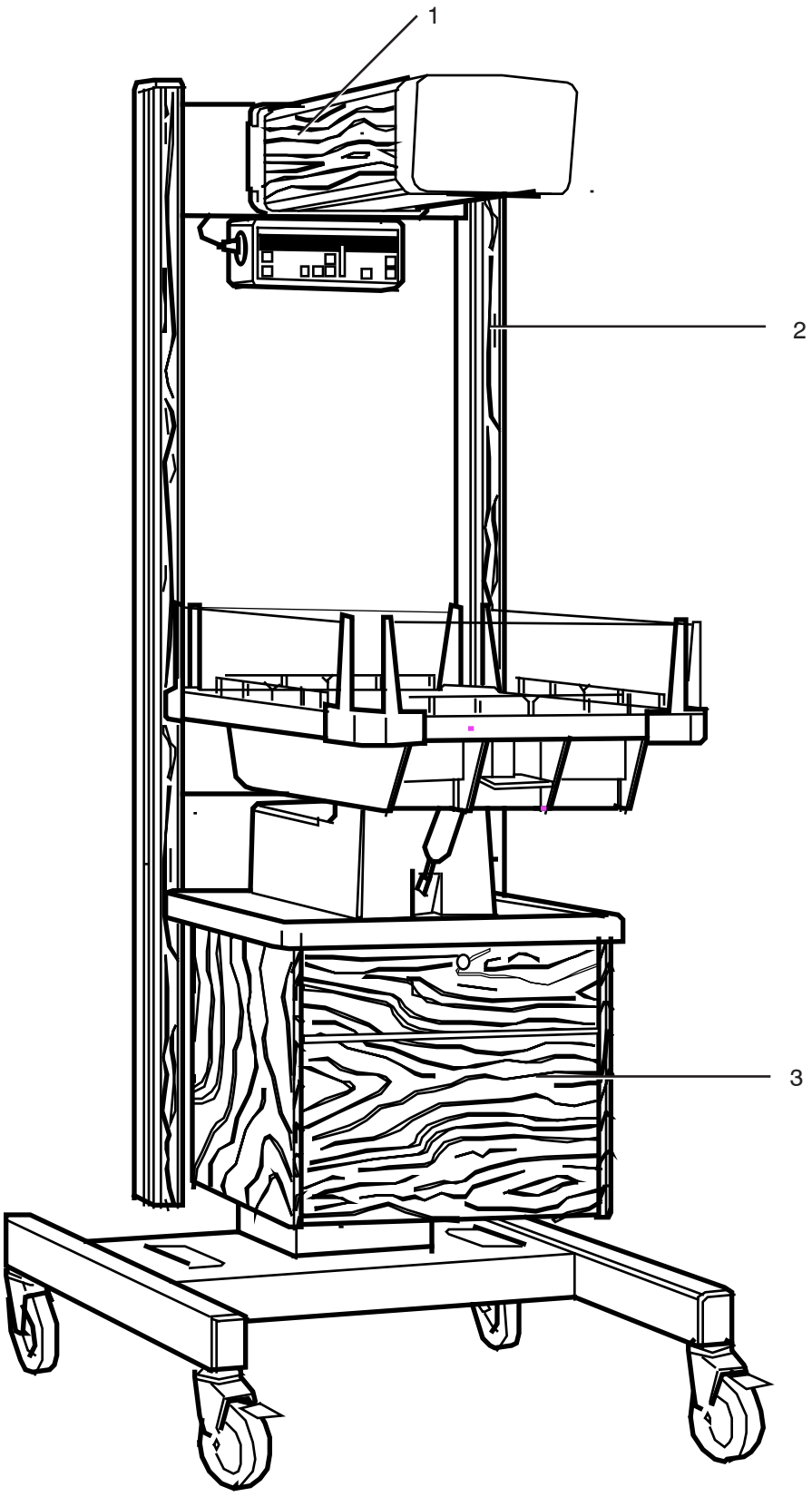


Figure 7-19
Wood Accent Parts

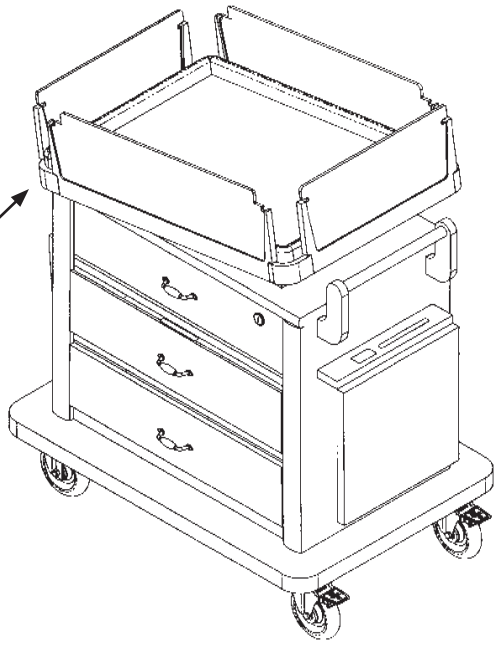
7.20 Well Baby Bassinet

7.21 Bed Assembly

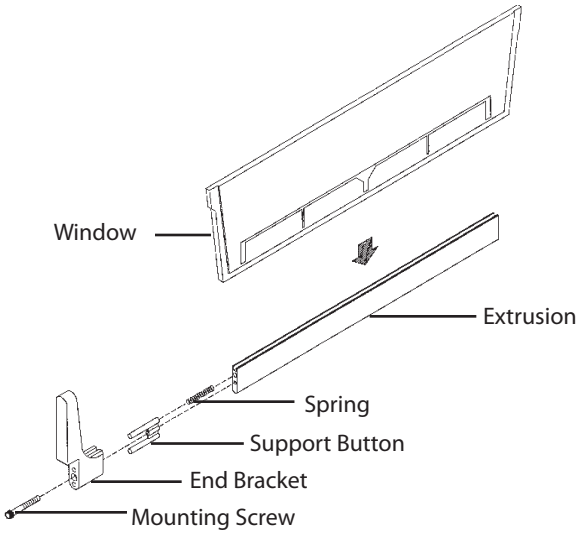
Description	Stock Number
Casters, locking	6600-0567-400
Casters, non-locking	6600-0566-400
Flip up shelf label	6600-1992-101
Shelf support hinge	6600-0779-204
Drawer weight label	6600-1998-101
Drawer lock	6600-0779-201
Drawer slides (2-left and right)	6600-0404-400
Plexiglass chart holder window	6600-0779-202
Tub model only	
Tub	6600-1006-500
Mattress for tub model (26.5" x 13")	6600-0998-500
Tub grommet	6600-0779-205
Side panel model only	
Mattress for side panel model (26.5" x 18")	6600-0999-500
Corner block kit (includes 4 blocks)	6600-0230-802
Mounting screw, 10-24 x 3/4	0400-3118-300
Lock washer, #10 split ring	6600-0322-400
Washer, .193 ID x .687 OD	0402-0739-300
Side panel assembly (left and right)	6600-0176-704
Side panel assembly (front and rear)	6600-0176-705
Side panel window (left and right)	6600-1003-500
Side panel window (front and rear)	6600-1002-500
Side panel extrusion (left and right)	6600-1001-500
Side panel extrusion (front and rear)	6600-1000-500
Side panel end bracket	6600-0810-501
Side panel spring	0203-3262-300
Side panel support button	0217-5275-100
Side panel mounting screw*	0144-2130-224
Side panel warning label	6600-1959-101

* Apply Loctite 242 (0220-5016-300)

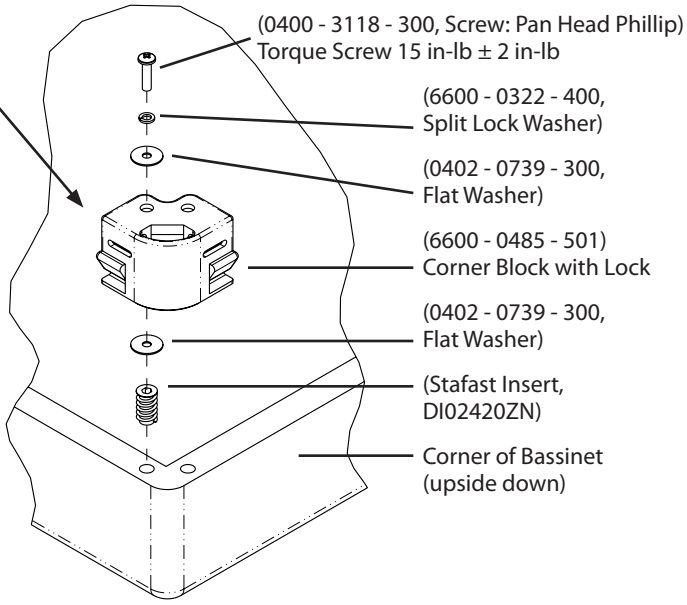
Side Panel Model



Side Panel Assembly

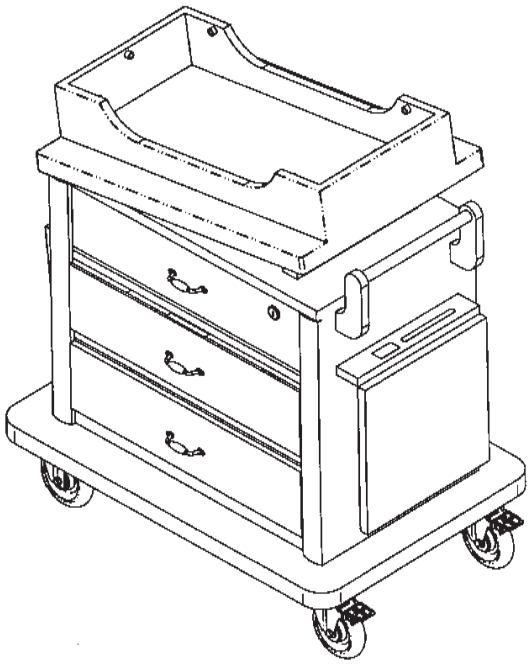


Corner Block Attachment for Side Panel Bassinet



Exploded View

Tub Model

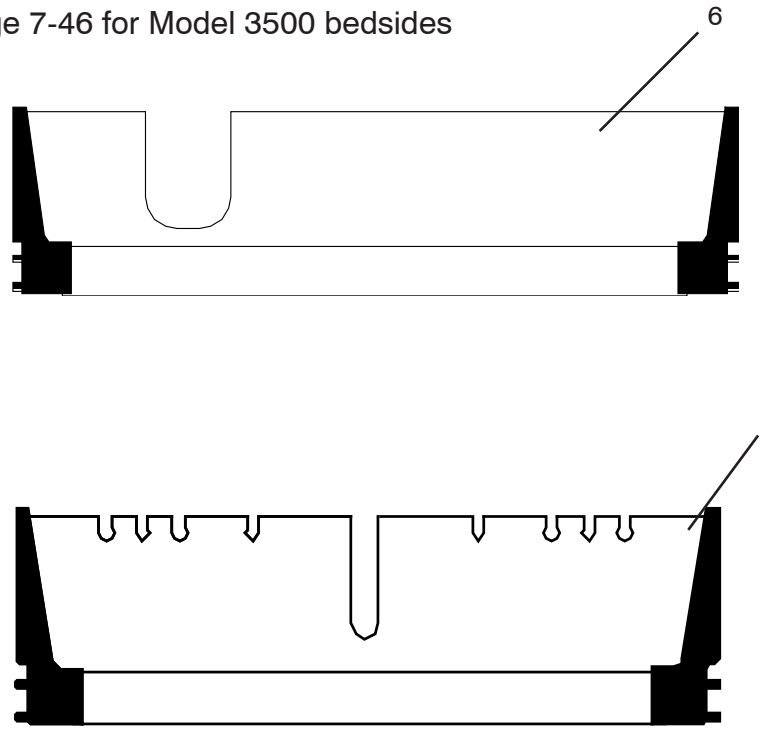


CI.14.038,180,181

Figure 7-20
Well Baby Bassinet

7.22 Bedside Assembly

See page 7-46 for Model 3500 bedsides



	Description	Stock Number
1.	Foam Mattress	
	Model 2001 and 3300	0305-5060-300
	Model 4300, 4400 & 5000	0305-5061-300
2.	Clear Plastic Bed Support	0217-5221-300
3.	Left and Right Bed Side Panel **	
	Model 2001 and 3300, 24" - black (new)	6600-0005-800
	Model 4300, 4400 & 5000, 28" - black	6600-0009-700
	Model 2001, 3300 & 3400, 24" - grey	6600-0004-853
	Model 4300 and 4400, 28" - grey	6600-0004-854
4.	Front and Rear Bed Side**	
	Model 2001 and 3300, 17" - black (new)	6600-0004-800
	Model 4300, 4400 & 5000, 22" - black	6600-0008-700
	Model 2001, 3300 & 3400, 17" - grey	6600-0004-855
	Model 4300 and 4400, 22" - grey	6600-0004-856
5.	Tubing Organizer Panel†	
	Model 2001 and 3300 - black	6600-0004-801
	Model 4300, 4400 & 5000 - black	6600-0004-802
	Model 2001, 3300 & 3400 - grey	6600-0004-857
	Model 4300 and 4400 - grey	6600-0004-858
6.	HFOV Panel‡	
	Model 2001, 3300 & 3400, 24" - grey	6600-0167-716
	Model 4300 and 4400, 28" - grey	6600-0167-718

† Tubing Organizer panel used for rear bedside only.

‡ HFOV panels can be used as side bedside panel only.

** Decals not included - refer to page 7-42 for part numbers.

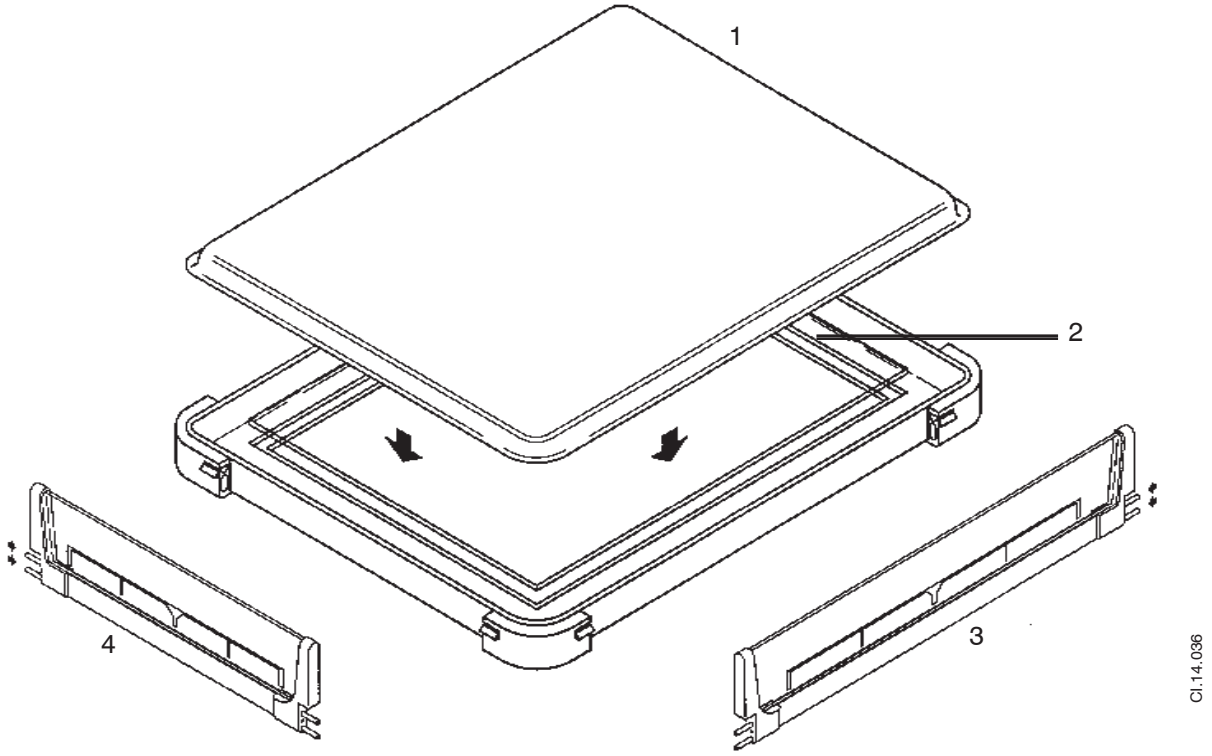
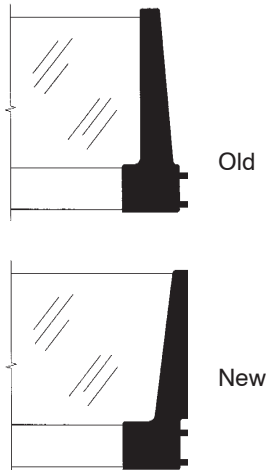


Figure 7-21
Bed Assembly except model 3500

7.23 X-ray tray assembly



CI.14.037

	Description	Stock Number
1.	Window, Front and Rear^	
	Model 2001, 3300 & 3400 (new)	6600-0021-500
	Model 2001 and 3300 (old)	0212-1001-300
	Model 4300, 4400 & 5000	0212-1003-300
	Model 3500§	6600-0325-500
	Window, Left and Right	
	Model 2001, 3300 & 3400 (new)	6600-0022-500
	Model 2001 and 3300 (old)	0212-1002-300
	Model 4300, 4400 & 5000	0212-1004-300
	Model 3500§	6600-0326-500
	HFOV panel window (4300, 4400 & 5000)	6600-0857-501
	HFOV panel window (2001, 3300 & 3400)	6600-0857-502
	Tubing Organizer Panel†	
	Model 2001, 3300 & 3400	6600-0567-500
	Model 4300, 4400 & 5000	6600-0566-500
2.	Extrusion, Front and Rear^	
	Model 2001, 3300, 3400 & 3500	0217-5280-300
	Model 4300, 4400 & 5000	0217-5183-300
	Extrusion, Left and Right	
	Model 2001, 3300, 3400 & 3500	0217-5281-300
	Model 4300, 4400 & 5000	0217-5184-300
3.	Spring	0203-3262-300
4.	Support Button - black	0217-5275-100
	Support Button - grey	6600-0603-401
5.	End Bracket (new) - black	0217-5291-100
	End Bracket - grey	6600-0810-501
6.	Mounting Screw*	0144-2130-224
7.	Side panel decal set (includes decals for all four panels)	
	Model 2001 and series 3000	6600-1530-100
	Model 4300, 4400 & 5000	6600-1531-100

* Apply Loctite 242 Stock No. 0220-5017-300

§ Model 3500 windows may be used on Model 3300 beds if higher bed sides are required.

† Tubing Organizer panel used for rear bedside only.

^ Decal not included - order item 7

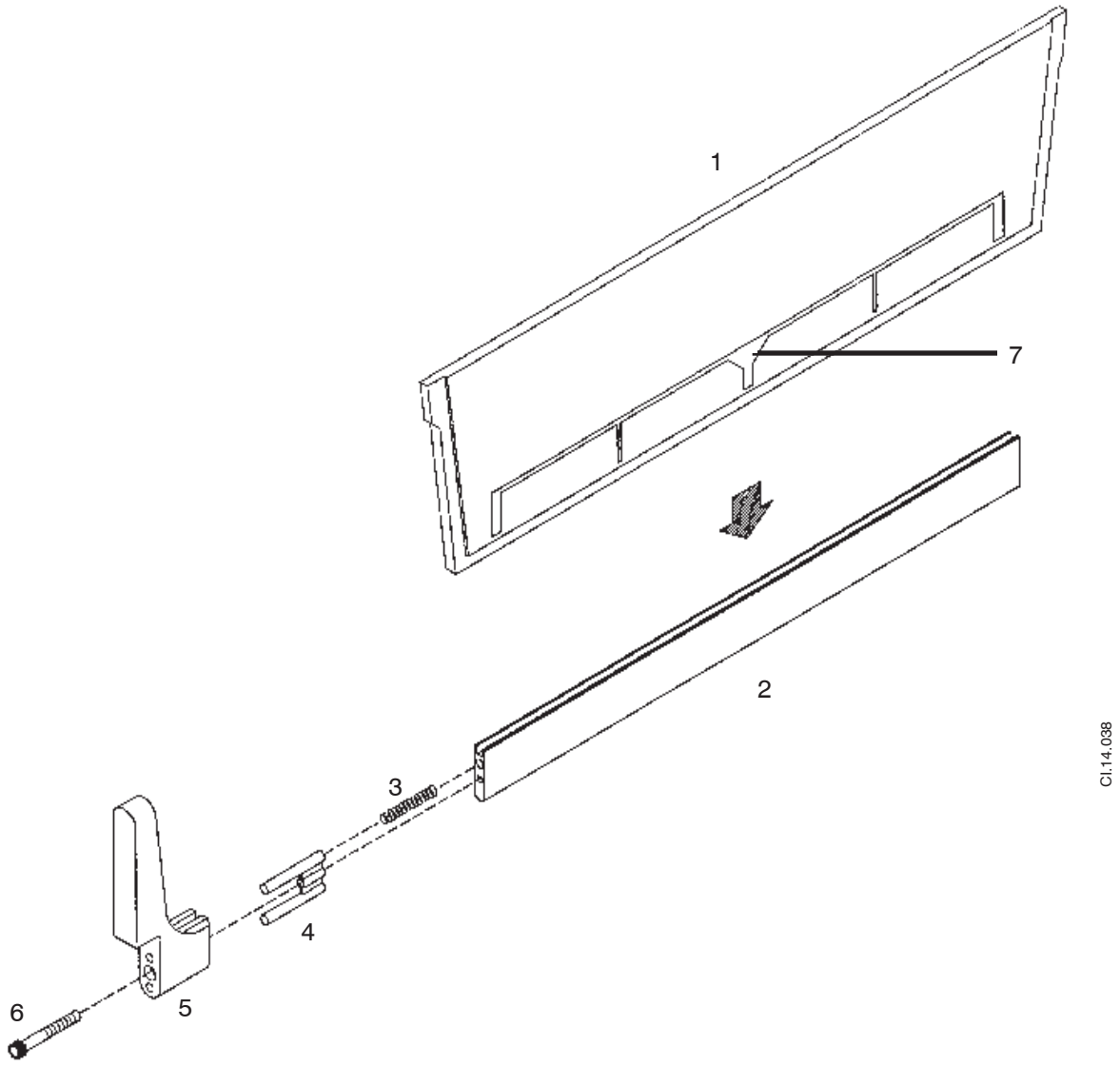


Figure 7-22
Bedside Assembly

7.25 Model 3500 Bassinet

Description	Stock Number
Grey parts	
1. X-ray tray, small bed, light grey (includes item 5)	6600-0003-854
X-ray tray, large bed, light grey (includes item 5)	6600-0003-855
2. Tray slide, small bed, light grey (1 slide only)	6600-0564-502
Tray slide, large bed, light grey (1 slide only)	6600-0564-503
3. Slide knob, light grey	6600-0549-400
4. Slide knob spacer, small bed	6600-0565-500
Large bed	6600-0565-501
5. Tray label set	6600-1992-101
Beige parts	
1. X-ray tray, small bed, beige only (includes item 5)	6600-0003-852
X-ray tray, large bed, beige only (includes item 5)	6600-0003-853
2. Tray slides kit (2) (includes items 3 & 4)	
small bed, beige only	6600-0004-850
large bed, beige only	6600-0004-851
3. Slide knob, beige	0212-1936-300
4. Slide knob spacer, small bed	6600-0565-500
large bed	6600-0565-501
5. Tray label set	6600-1537-100
Parts not shown	
Window decal sets (Shown on page 7-37)	
Small bed	6600-0005-850
Large bed	6000-0005-851
X-ray tray upgrade kit (includes all items above)	
Small bed, beige only	6600-0003-850
Large bed, beige only	6600-0003-851

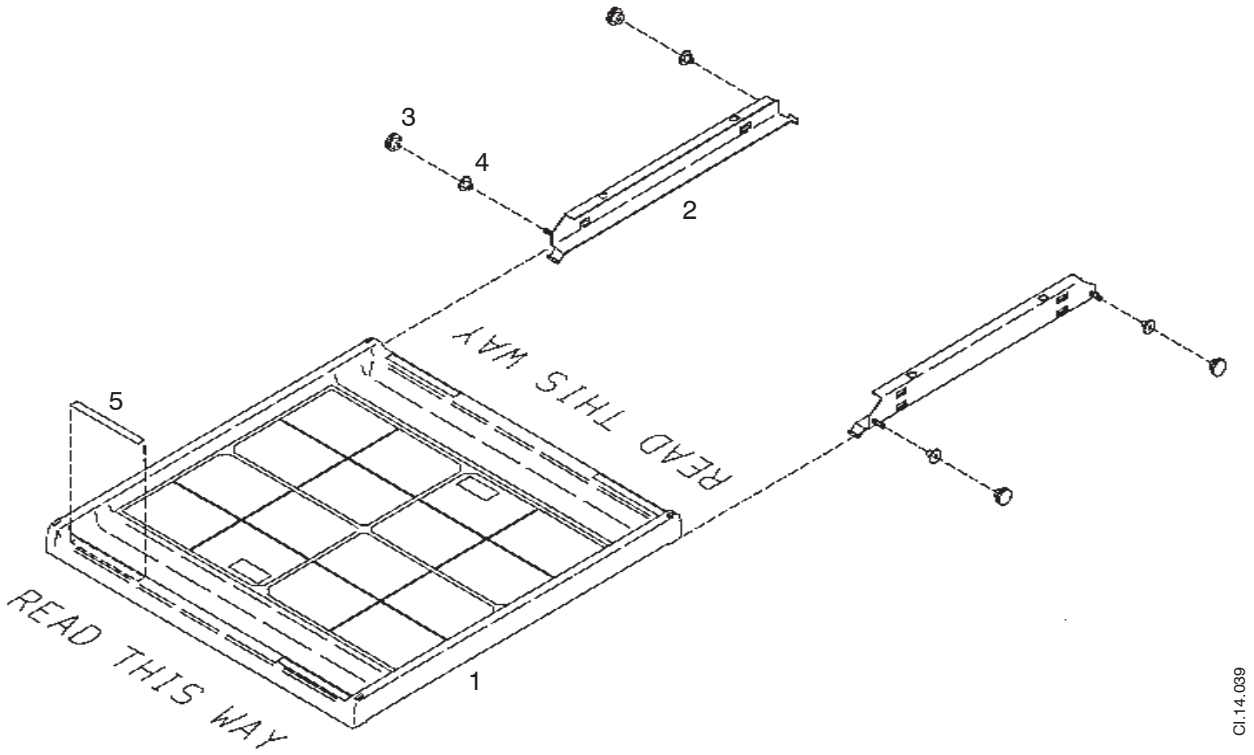
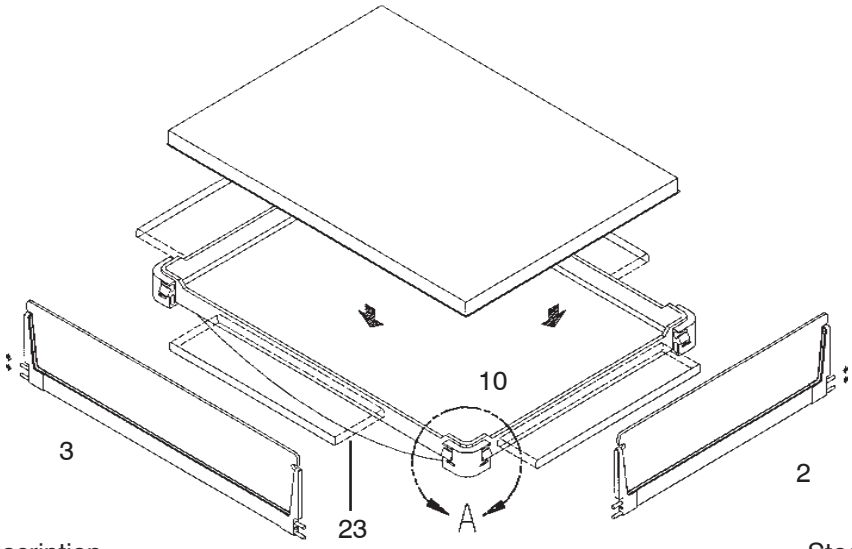


Figure 7-23
X-ray tray assembly



	Description	Stock Number
1.	Mattress, Foam, Poly	0305-5060-300
2.	Window, Bed Side, black, Front and Rear	6600-0176-700
	Window, Bed Side, grey, Front and Rear	6600-0176-702
3.	Window, Bed Side, black, Left and Right	6600-0176-701
	Window, Bed Side, grey, Left and Right	6600-0176-703
4	Collar, Setscrew, 0.5 Dia	6600-0169-400
5.	Spring, Comp, Tilt	6600-0168-400
6.	Handle, Inner Adj*	6600-0284-500
7.	Tube Handle, Inner Coupler	6600-0309-500
8.	Screw, 10-24 x 3/8	6600-0250-400
9.	Washer, lk, #10, slit ring	6600-0322-400
10.	Corner Block, locking, black (includes 8, 9, 24 & 25)	6600-0185-700
	Corner Block, locking, grey (includes 8, 9, 24 & 25)	6600-0185-701
	Corner Block, locking, black (Pkg 4 - includes 8, 9, 24 & 25)	6600-0230-800
	Corner Block, locking, grey (Pkg 4 - includes 8, 9, 24 & 25)	6600-0230-801
11.	Label Lot ID	6600-0541-100
12.	Bed assembly, beige (includes everything shown on page 7-47)	6600-0191-700
	Bed assembly, grey (includes everything shown on page 7-47)	6600-0191-701
13.	Bushing, Pivot, Bed**	6600 0288-500
14	Ring, Truarc, .500 Shaft	0203-5227-300
15.	Rod, Pivot, Bed Tilt	6600-0285-500
16.	Spacer, Index Tilt	6600 0304-500
17.	Pin, Spring, .094 x 0.5 sst	6600-0170-400
18.	Spacer	6600-0287-500
19.	Pin, Indexing, Tilt	6600-0286-500
20.	O-ring, .375 ID .562	6600-0402-400
21.	Screw, 1/4-20 x .625, rh, ph, sst†	6600-0394-400
22.	Handle, Outer Fixed	6600-0283-500
23.	Label, Warning, Bedside, 3500 IWS	See label section
24.	Flat Washer	0202-4518-340
25.	O-ring	6600-0348-400

* Apply Loctite 290 Stock No. 0220-5031-300 to the curved end which fits into the inner coupler tube handle. Remove excess adhesive. Position in bed and align with center pivot prior to Loctite application.

** Apply Loctite 290 Stock No. 0220-5031-300. Remove excess adhesive (center bushings only). Position flange against retaining ring prior to Loctite application.

† Apply Loctite 242 Stock No. 0220-5017-300 sparingly.

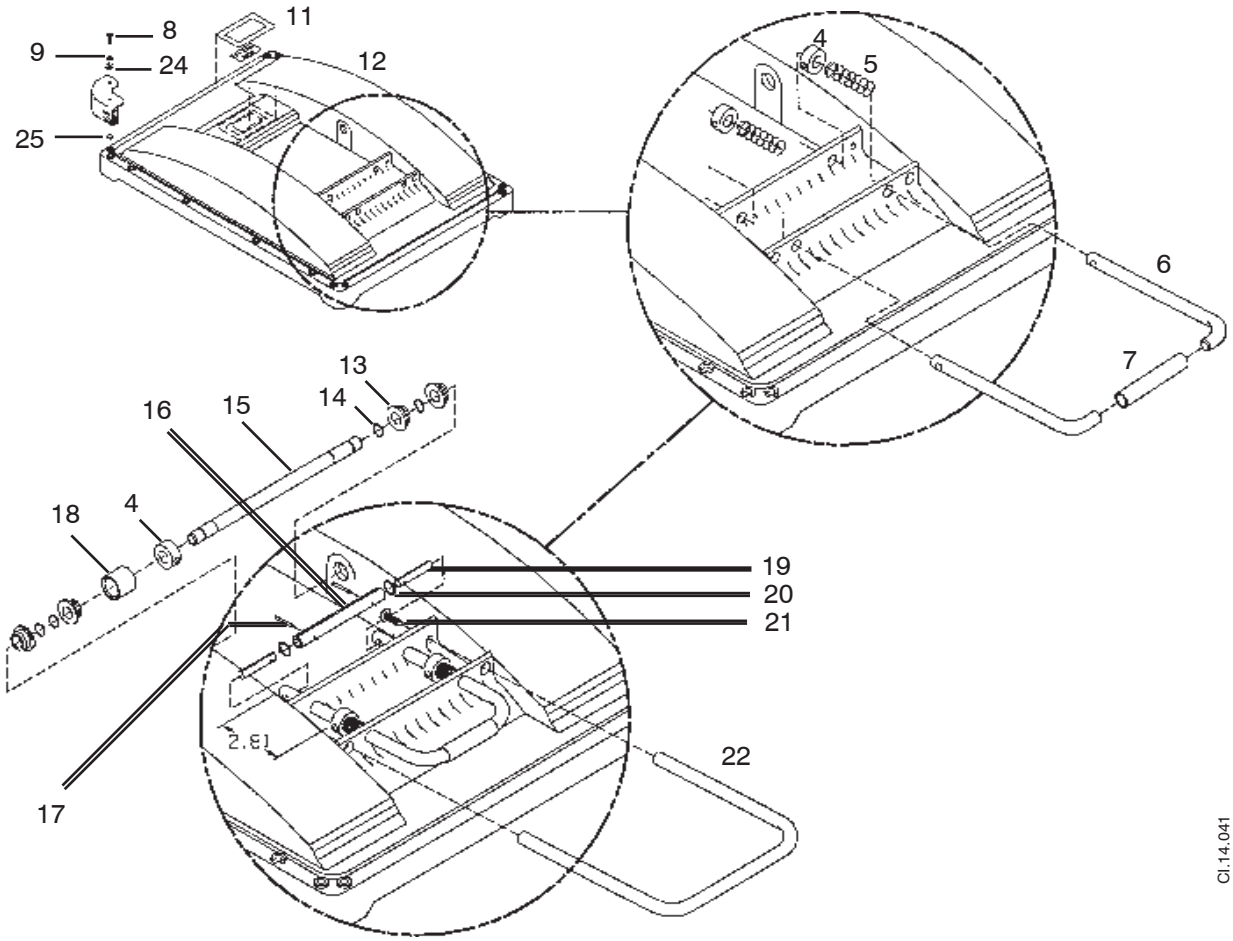


Figure 7-24
Model 3500 Bed Assembly

7.25 Model 3500 Bassinet

	Description	Stock Number
1.	Cover, Cabinet (beige)	6600-0657-500
	Cover, Cabinet (grey)	6600-0657-501
2.	Screw, 1/4-20 x 3.75 Cap	6600-0186-400
3.	Bracket, Indexing Pivot (beige)	6600-0282-500
	Bracket, Indexing Pivot (light grey)	6600-0282-501
4.	Knob, Docking†	6600-0174-400
5.	O-ring, .375 ID .562	6600-0402-400
6.	Rod, Thd, .164 x 32 x 3.5 stl pl§	6600-0503-400
7.	Rod, Thd, .164 x 32 x 3 stl pl§	6600-0502-400
8.	Nut, Kep, #8-32 w/ Ext Lkwshr	0202-1131-300
9.	Washer, Neoprene	6600-0504-400
10.	Rod, Docking	6600-0289-500
11.	Washer, Flt, .63 OD .38 ID x .06 sst	6600-0173-400
12.	Spring, Tilt	6600-0060-400
13.	Collar, Docking	6600-0176-400
14.	Washer	0202-4004-300
15.	Bearing, Docking Plastic^	6600-0305-500
16.	Plunger, Docking	6600-0290-500
17.	Pin, Spring, 0.125 x 1.0 sst	6600-0172-400
18.	Bracket, Dock Left	6600-0292-500
19.	Screw, 10-24 x 1-1/4 trs ph*	0140-6130-120
20.	Washer, lk. #10, .047T	0202-3015-340
21.	Washer, .193 ID, .438 OD	6600-0494-400
22.	Bracket, Dock Right	6600-0291-500
23.	Caster, non-locking	6600-0167-400
24.	Screw, 5/16-18 x 1**	0144-2440-216
25.	Washer, lk., int, 5/16, st	0202-3418-300
26.	Caster, Locking	6600-0166-400
27.	Rod, Pivot, Bed Tilt	6600-0285-500
28.	Collar, Setscrew, 0.5 Dia	6600-0169-400
29.	Spacer	6600-0287-500
30.	Warning label (5 lbs limit)	see label section
31.	Warning label (8 lbs limit)	see label section
32.	Casting base weight	0217-5038-100
33.	Nut, hex 5/16-18	6600-0071-200
34.	Carriage bolt	6600-0446-400
35.	Nut, elastic 1/4-20	0144-3536-113
36.	Lock	6600-0213-400
37.	Washer .175 ID x .875 OD	0402-1133-300
38.	Nut, elastic 8-32 stop	0202-1008-300

Parts not shown

Drawer slide, 16" long with rollers, left	6600-0331-500
Drawer slide, 16" long with rollers, right	6600-0332-500
Drawer rail, 16" long with rollers, left	6600-0202-400
Drawer rail, 16" long with rollers, right	6600-0204-400
Drawer slide, 18" long with ball bearings, left	6600-0133-400
Drawer slide, 14" long with ball bearings, right	6600-0132-400
Drawer slide, 14" long with ball bearings, left	6600-0134-400
Pass through drawer rail and slide	6600-0425-800

* Torque 35 in. lb. ± 5 in. lb.

** Torque 105 in. lb. ± 10 in. lb.

† Apply Loctite 242 Stock No. 0220-5017-300 sparingly.

§ Apply Loctite 290 Stock No. 0220-5031-300 sparingly to top end only.

^ Apply silicone rubber sealant Stock No. 0220-5250-300 under flange before insertion.

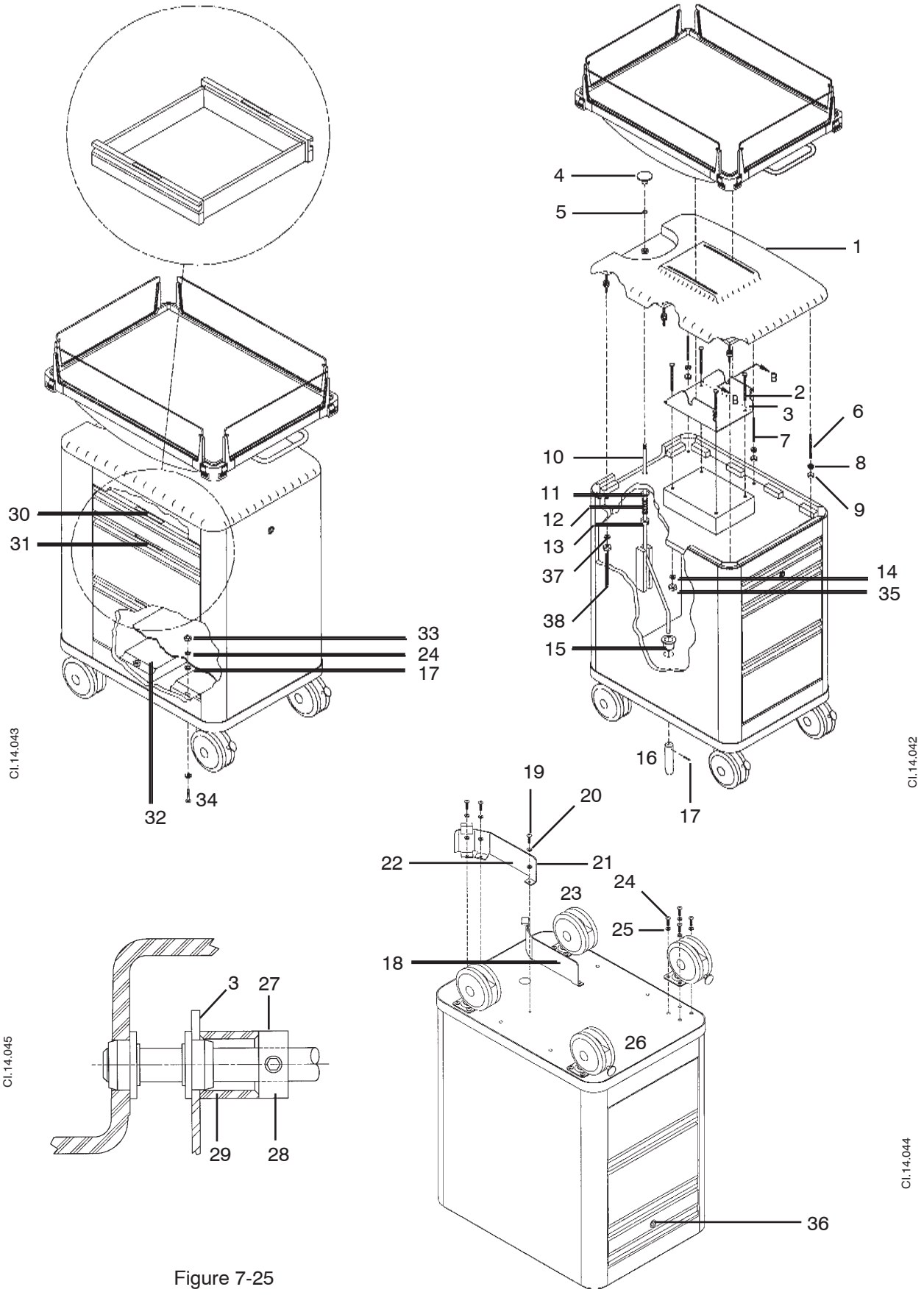
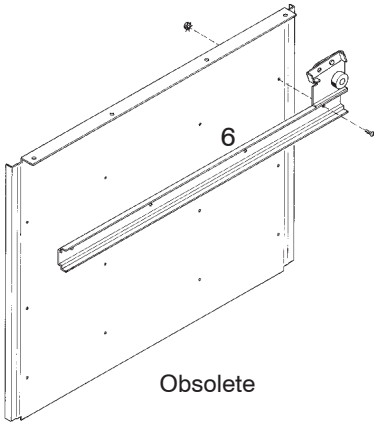


Figure 7-25
Model 3500 Bassinet

7.26 Drawer Assembly



Obsolete

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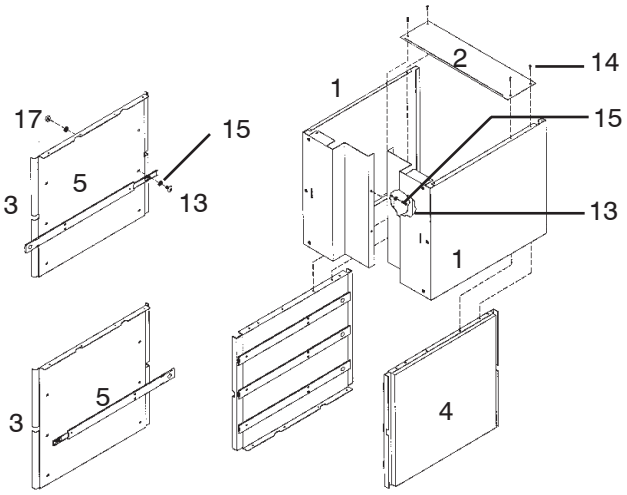

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	Description	Stock Number
1.	Outer cabinet panel (beige)	0217-5356-710
	Outer cabinet panel (light grey)	6600-0817-501
2.	Cabinet side spacer	0214-1574-510
3.	Drawer side panel	0214-1572-510
4.	Insulation	6600-0190-500
5.	Drawer slide channel*	6600-0133-400
6.	Right slide channel (old) shown	0203-2510-300
	Left slide channel (old)	0203-2509-300
7.	Plastic Drawer Kit, shallow (beige) (includes slides)**	6600-0058-850
	Plastic Drawer Kit, shallow (light grey) (includes slides)**	6600-0059-850
8.	Drawer front, shallow (blue)†	0214-1576-510
	Drawer front, shallow (light grey)	6600-0863-501
9.	Drawer slide spacer	6600-0089-500
10.	Nut, hex elastic locking 6/32	6600-0111-400
11.	Right drawer slide track	6600-0132-400
	Right drawer slide track (old)	0203-2507-400
12.	Left drawer slide track	6600-0134-400
	Left drawer slide track (old)	0203-2508-400
13.	Screw, 6-32 x 3/8	0140-6624-106
14.	Screw, #8 x 3/8	6600-0471-400
15.	Lock washer, external	6600-0259-400
16.	Flat washer, #6	6600-0378-400
17.	Nut, elastic	6600-0111-400
18.	Rivet	6600-0155-400
19.	Screw, #10-24 x 3/8	6600-0250-400
20.	Lock washer, #10 internal	0144-1110-131
21.	Screw, 8-32 x 3/8	0140-6127-106
22.	Lock washer, #8 internal	6600-0262-400
23.	Washer (stationary drawers only)	6600-0252-400
24.	Washer, split ring (stationary drawers only)	0144-1114-331
25.	Bolt, 1/4 - 20 x 1 1/2 (stationary drawers only)	6600-0012-400
	Bolt, flat hd, 1/4 - 20 x 1 5/8 (rotating drawers only)	6600-0447-400
26.	Cabinet top, large - (beige) (shown)	6600-0601-500
	Cabinet top, large - (light grey)	6600-0601-501
27.	Cabinet top, small - (beige) (used on small bed stationary drawer cabinets only)	6600-0025-500
	Cabinet top, small - (light grey)	6600-0025-501
28.	Plastic drawer, deep - (includes slides) (light grey)**	6600-0060-850
29.	Drawer front, deep - (light grey)	6600-0838-501
	Drawer front, deep - (blue)	6600-0838-500
30.	Rear cabinet cover (beige)	6600-0590-500
	Rear cabinet cover (light grey)	6600-0590-501
31.	Hook bracket (units with AAN & HCA serial number)	0214-1573-542
32.	Plate bracket (units with AAN & HCA serial number)	0214-1577-542
33.	Lock washer, #8 (units with AAN & HCA serial number)	6600-0262-400
34.	Screw, 8-32 x 9/16 (units with AAN & HCA serial number)	0140-6627-109

* Apply Lubriplate (0616-0203-300) to contact areas.

† Use tape transfer acrylic (0220-5119-300) to attach front to drawer.

** Does not include drawer fronts.

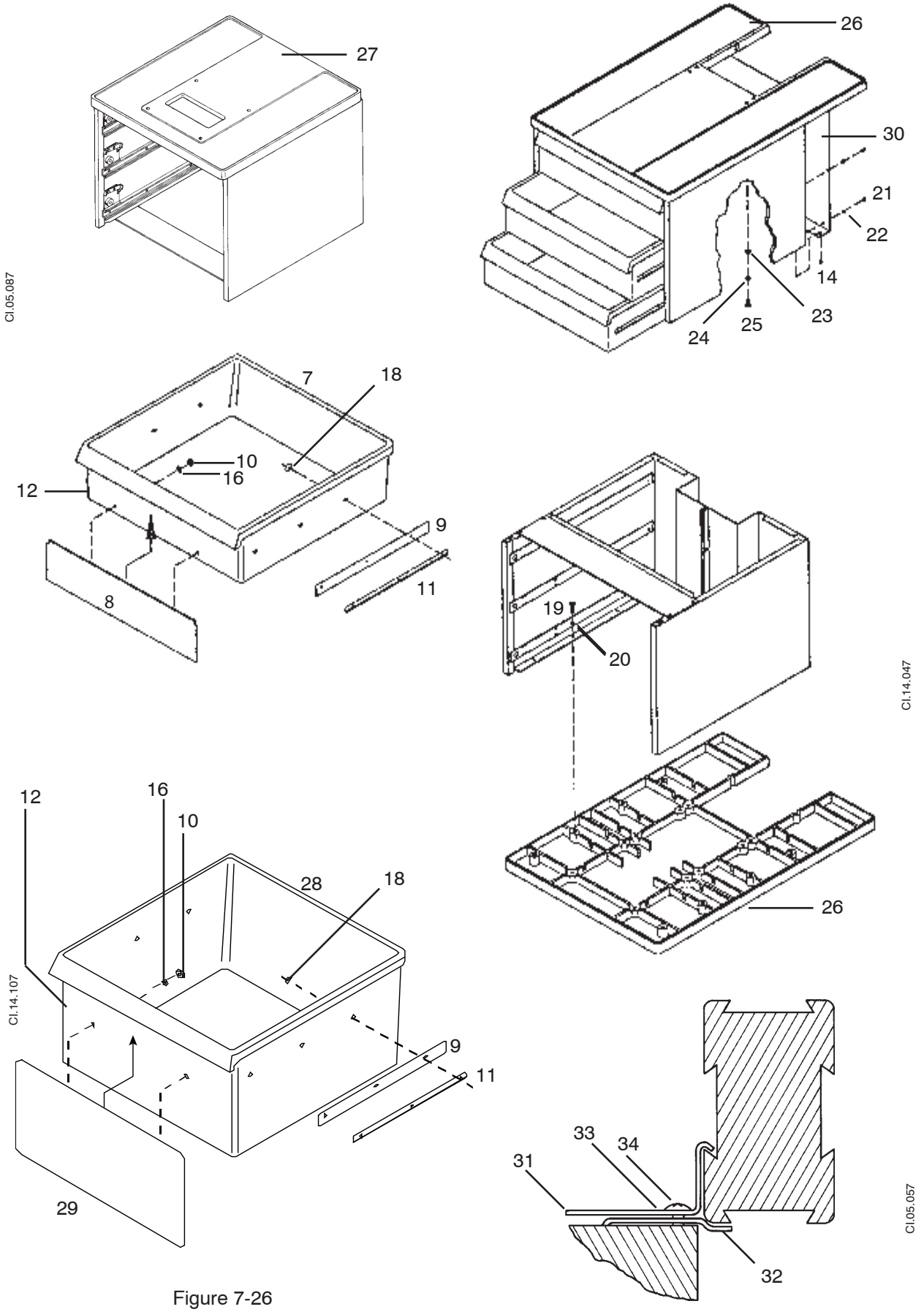


Figure 7-26
Drawer Assembly

7.27 Rotating drawer assemblies

	Description	Stock Number
1.	Lower rotating plate	6600-0573-500
2.	Drawer cover (beige)	6600-0583-500
	Drawer cover (light grey)	6600-0583-501
3.	Upper rotating plate (model 2001/3300)	6600-0574-501
	Upper rotating plate§ (model 4300/4400/5000)	6600-0574-500
4.	Pinch shield*	6600-0582-500
5.	Molded top (beige) *	6600-0601-500
	Molded top (light grey)	6600-0601-501
6.	Rear cover (beige)	6600-0590-500
	Rear cover (light grey)	6600-0590-501
7.	Carriage bolt, 1/2-13 x 1.75	6600-0580-500
8.	Bearing ring†	6600-0576-500
9.	Shoulder washer	6600-0581-500
10.	Slotted hex nut	6600-0424-400
11.	Cotter pin	6600-0426-400
12.	Cam follower †	6600-0577-500
13.	Roller	6600-0578-500
14.	Spacer	6600-0427-400
15.	Extension spring	6600-0425-400
16.	Screw, 6-32 x 1" Flt Hd	6600-0432-400
17.	Screw, 10-24 x 3/8 Ph Hd*	6600-0250-400
18.	Screw, #8 x 3/8	0142-4234-106
19.	Screw, 8-32 x 3/8 Ph Hd	0140-6127-106
20.	Nut, elastic	6600-0111-400
21.	Lock Washer, #8 Internal	6600-0262-400
22.	Bearing	6600-0428-400
23.	Screw, 6-32 x 3/8 Ph Hd	0140-6124-106
24.	Lock washer, #10 internal	0144-1110-131

* Apply a 1/8" thick bead of Sealant Silicone Rubber (0220-5250-300) any where item #4 and #5 contact.

† Apply Lubriplate (0616-0203-300) to any areas subject to friction.

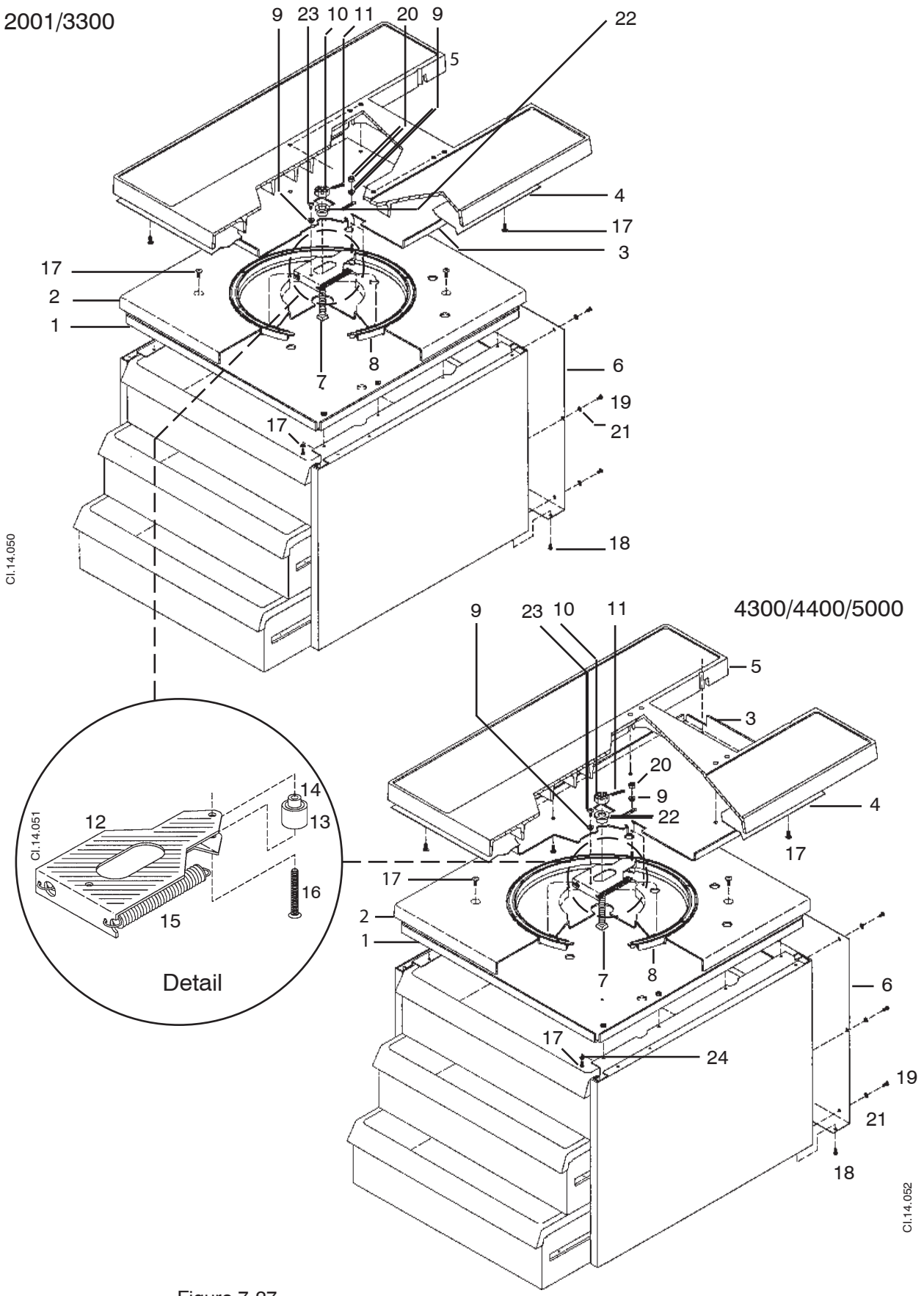


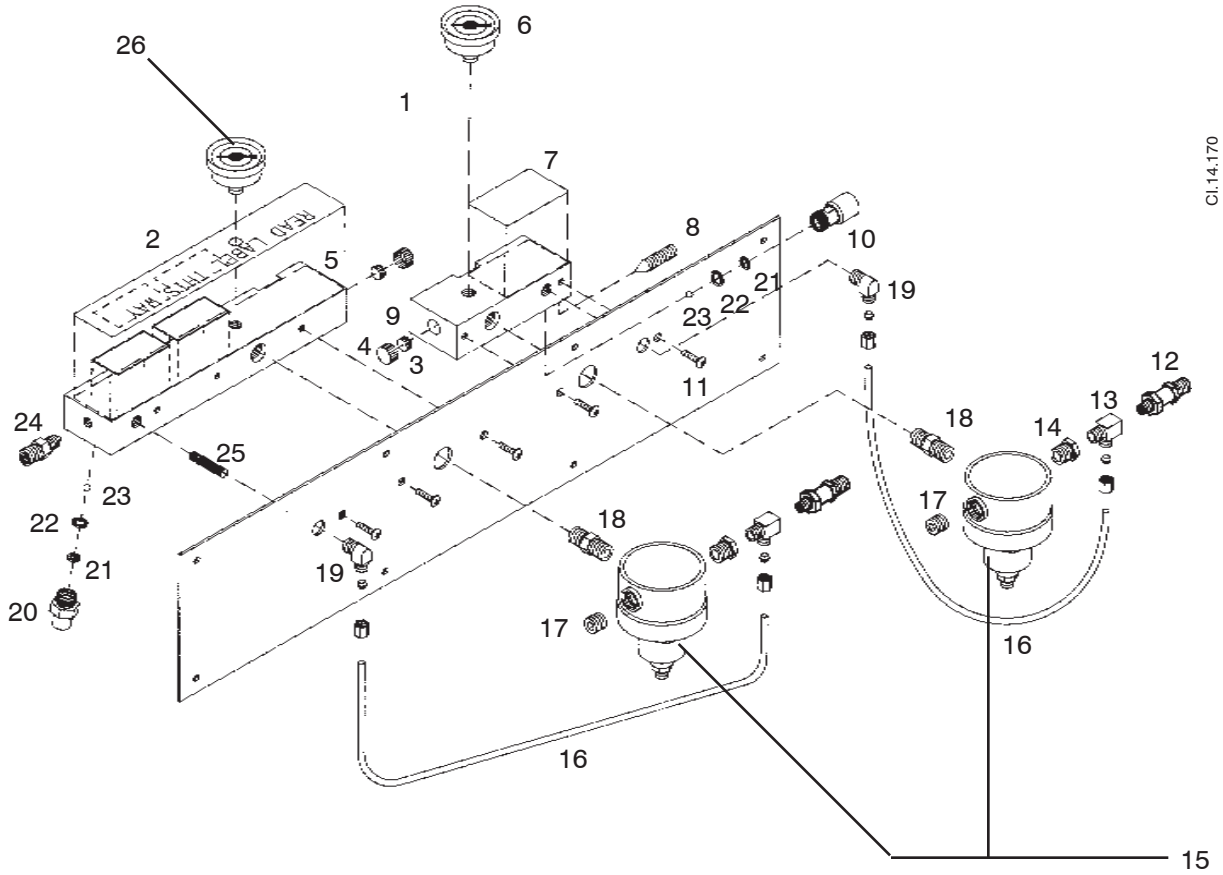
Figure 7-27
Rotating drawer assemblies

7.28 Air/Oxygen Yoke and Regulator Assembly1-Regulator

	Description	Stock Number
1.	O_2 Gauge, 3000 lbs (210 kg/cm^2)	6600-0269-400
2.	Label, Oxygen Yoke Assembly	see label section
3.	Plug 1/8 nptm w/Hex Socket	6600-0191-400
4.	Button Plug	0216-2593-300
5.	O_2 Manifold Yoke	0219-4002-531
6.	Air Gauge, 3000 lbs (210 kg/cm^2)	6600-0269-401
7.	Label, Air Yoke Assembly	see label section
8.	Socket Head Set Cup Screw 6-32 x 3/8	0141-4124-112
9.	Air Manifold Yoke	6600-0023-500
10.	Air Outlet DISS 1/8 nptm Single Check	6600-0021-400
11.	Screw 1/4 -20 x 3/8	0140-6136-106
12.	Safety Relief Valve	6600-0550-800
13.	Tee, 1/8 nptf 1/8 nptm 3/16	0213-4127-300
14.	Bushing 1/8 nptf 1/4 nptm	6600-0035-300
15.	Single Stage O_2 Regulator 8000 Series	6600-0003-700
16.	Copper Tube	0213-8022-300
17.	Hex Socket Plug 1/4 nptm	0413-3511-335
18.	Close Nipple 1/4 npt	0413-1099-325
19.	3/16 Compression Elbow 1/8 nptm	6600-0274-400
20.	O_2 Connector DISS 9/16	0204-0508-532
21.	O-Ring .250 ID .375 OD	0210-0595-300
22.	O-Ring .312 ID .437 OD	0210-0601-300
23.	Steel Ball	0409-1697-300
24.	O_2 DISS Outlet 1/8 nptm Single Check	0205-0540-800
	Piston	0205-0413-535
	O-Ring	0210-0559-300
	Adapter	0205-0412-535
25.	Screen*	6600-0461-400
26.	Gauge lens	0212-0066-300
27.	Cylinder Bumper	6600-0400-500
28.	Screw, Phillips FL type F, # 8 x 5/8	0142-2244-210

Note: Seal pipe threads with Teflon tape.

* Some older units have a spring instead of a screen.



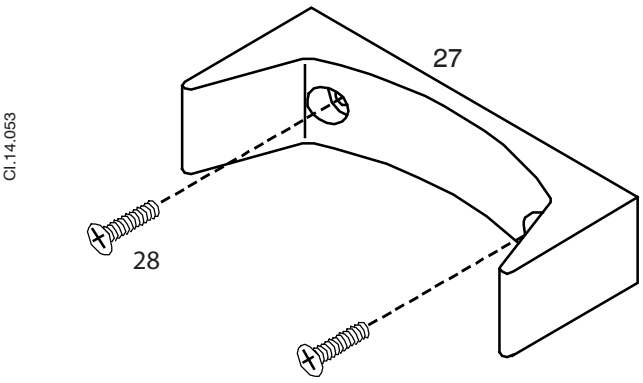


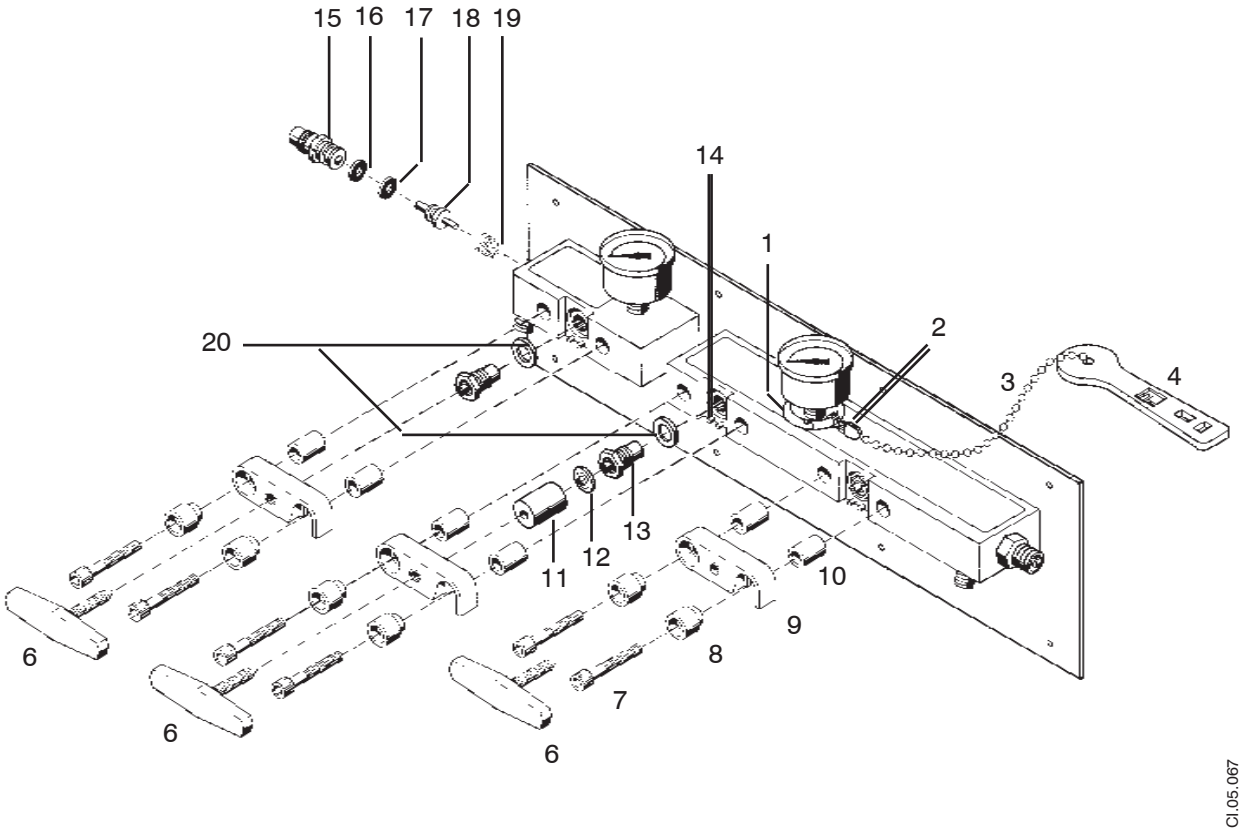
Figure 7-28
Air/Oxygen Yoke and Regulator Assembly 1 - Regulator

7.29 Air/Oxygen Yoke and Regulator Assembly 2 - Manifold Block

	Description	Stock Number
1.	Split Ring, 1 inch	0203-2390-300
2.	Bead Chain Clip	0203-0100-300
3.	Bead Chain, No. 10 (3/16 inch)	0203-0068-500
4.	Cylinder Wrench	6600-0308-400
5.	Cylinder guard (model 5000 only)	6600-0040-500
6.	Tee Handle	6600-0270-401
7.	Screw 3/8-16 x 2 1/4	0144-2145-224
8.	Sleeve	6600-0271-400
9.	Gate Hanger	6600-0348-500
10.	Yoke Spacer	6600-0121-400
11.	Yoke Plug	6600-0399-500
12.	Gasket	6600-0152-400
13.	Yoke Check Valve Kit*	6600-0118-850
	Strainer Nipple	0206-2805-725
14.	Groove Pin	0143-3210-410
15.	Front Body Air DISS Check Unit	6600-0402-500
16.	O-Ring	6700-0136-500
17.	O-Ring	0210-0591-300
18.	Air Primary Check	0221-3661-535
19.	Spring	6600-0283-400
20.	Washer*	6600-0032-300

* Torque to 15 -20 ft./lbs. Replace sealing washer (Item 20) when replacing check valve. Thinly coat washer with Vac Kote (6700-0092-002) or Sentinel OPG (6700-0067-002), place on check valve, then tighten into manifold.

Note: Seal pipe threads with Teflon tape.



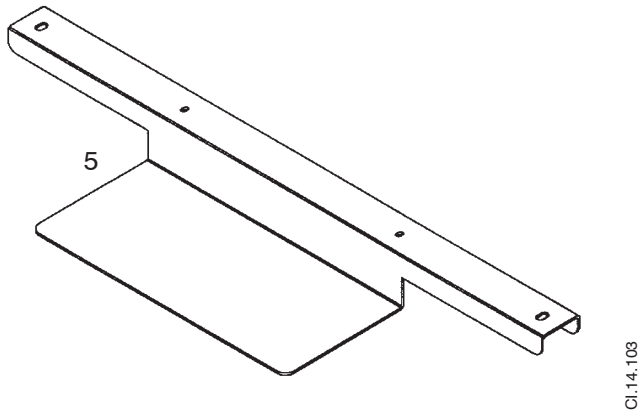


Figure 7-29
Air/Oxygen Yoke and Regulator Assembly 2 - Manifold Block

7.30 Oxygen Yoke and Regulator Assembly 1 - Regulator

	Description	Stock Number
1.	O_2 Gauge, 3000 lbs (210 kg/cm^2)	6600-0269-400
2.	Label, Oxygen Yoke Assembly	see label section
3.	Plug 1/8 nptm w/Hex Socket	6600-0191-400
4.	Button Plug	0216-2593-300
5.	O_2 Manifold Yoke	0219-4002-531
6.	Screw 1/4-20 x 3/8	0140-6136-106
7.	Safety Relief Valve	6600-0550-800
8.	Tee, 1/8 nptf 1/8 nptm 3/16	0213-4127-300
9.	Bushing 1/8 nptf 1/4 nptm	0413-3350-300
10.	Single Stage O_2 Regulator (8000)	6600-0003-700
11.	Copper Tube	0213-8022-300
12.	Hex Socket Plug 1/4 nptm	0413-3511-335
13.	Close Nipple 1/4 npt	0413-1099-325
14.	3/16 Compression Elbow 1/8 nptm	6600-0274-400
15.	O_2 Connector DISS 9/16	0204-0508-532
16.	O-Ring .250 ID .375 OD	0210-0595-300
17.	O-Ring .312 ID .437 OD	0210-0601-300
18	Steel Ball	0409-1697-300
19.	O_2 DISS Outlet 1/8 nptm Single Check	0205-0540-800
	Piston	0205-0413-535
	O-Ring	0210-0559-300
	Adapter	0205-0412-535
20.	Screen*	6600-0461-400
21.	Gauge lens	0212-0066-300

Note: Seal pipe threads with Teflon tape.

* Some older units have spring instead of a screen.

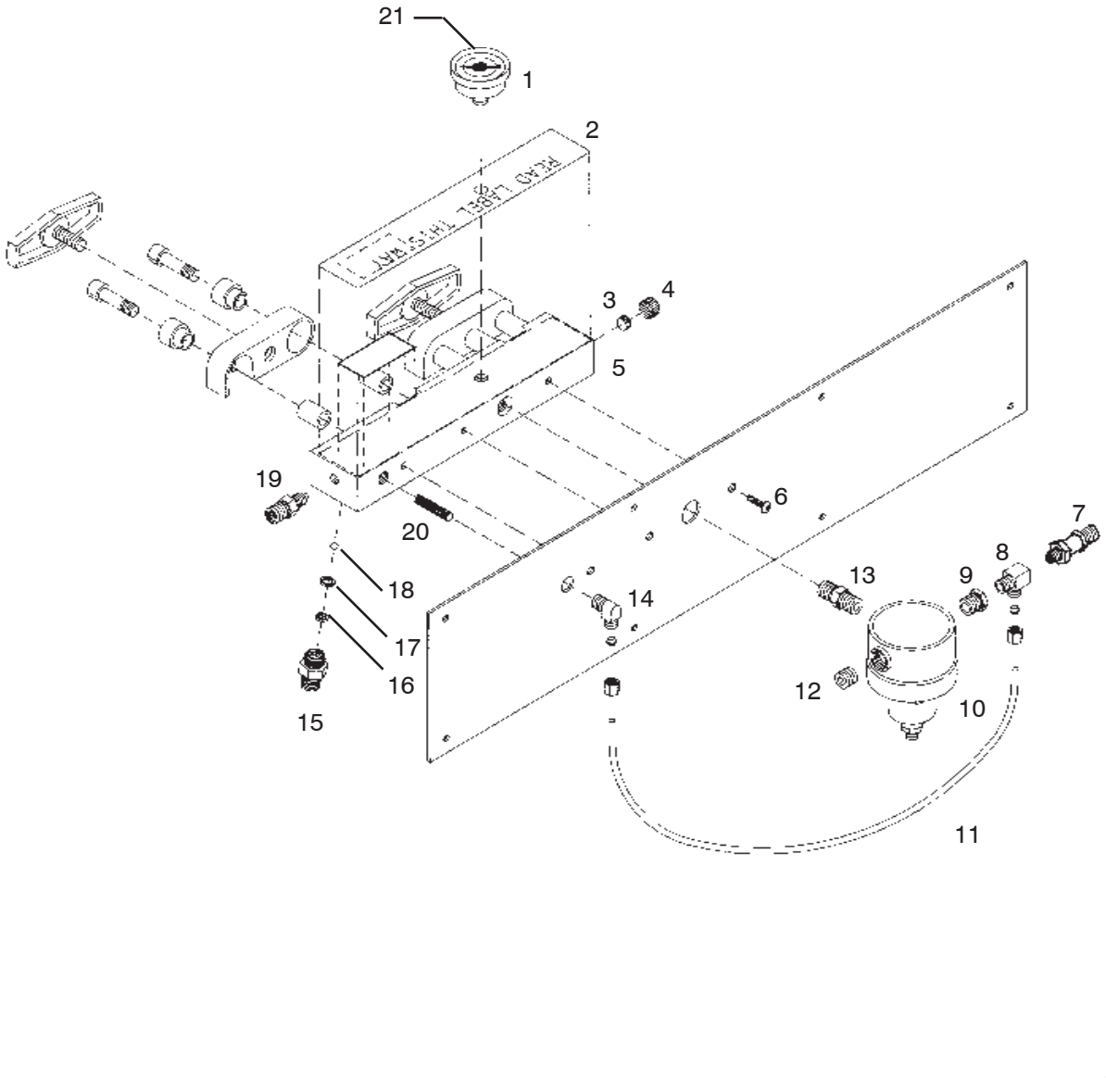


Figure 7-30
Oxygen Yoke and Regulator Assembly 1 - Regulator

7.31 Oxygen Yoke and Regulator Assembly 2 - Manifold Block

	Description	Stock Number
1.	Split Ring, 1/2 inch	0203-2390-300
2.	Bead Chain Clip	0203-0100-300
3.	Bead Chain, No. 10 (3/16 inch)	0203-0068-500
4.	Cylinder Wrench	6600-0308-400
5.	Cylinder guard (Model 5000 only)	6600-0040-500
6.	Tee Handle	6600-0270-401
7.	Screw 3/8-16 x 2-1/4	0144-2145-224
8.	Sleeve	6600-0271-400
9.	Gate Hanger	6600-0348-500
10.	Yoke Spacer	6600-0121-400
11.	Yoke Plug	6600-0399-500
12.	Gasket	6600-0152-400
13.	Yoke Check Valve Kit*	6600-0118-850
	Strainer Nipple	0206-2805-725
14.	Washer*	6600-0032-300
15.	Groove Pin	0143-3210-410
16.	Gauge lens	0212-0066-300
17.	Lock washer, pyramidal (model 5000 only)	0202-3419-300
18.	Screw, button head cap, 5/16-1 (model 5000 only)	0144-2440-216

* Torque to 15 -20 ft./lbs. Replace sealing washer (item 14) when replacing check valve. Thinly coat washer with Vac Kote (6700-0092-200) or Sentinel OPG (6700-0092-002) place on check valve, then tighten into manifold.

Note: Seal pipe threads with Teflon tape.

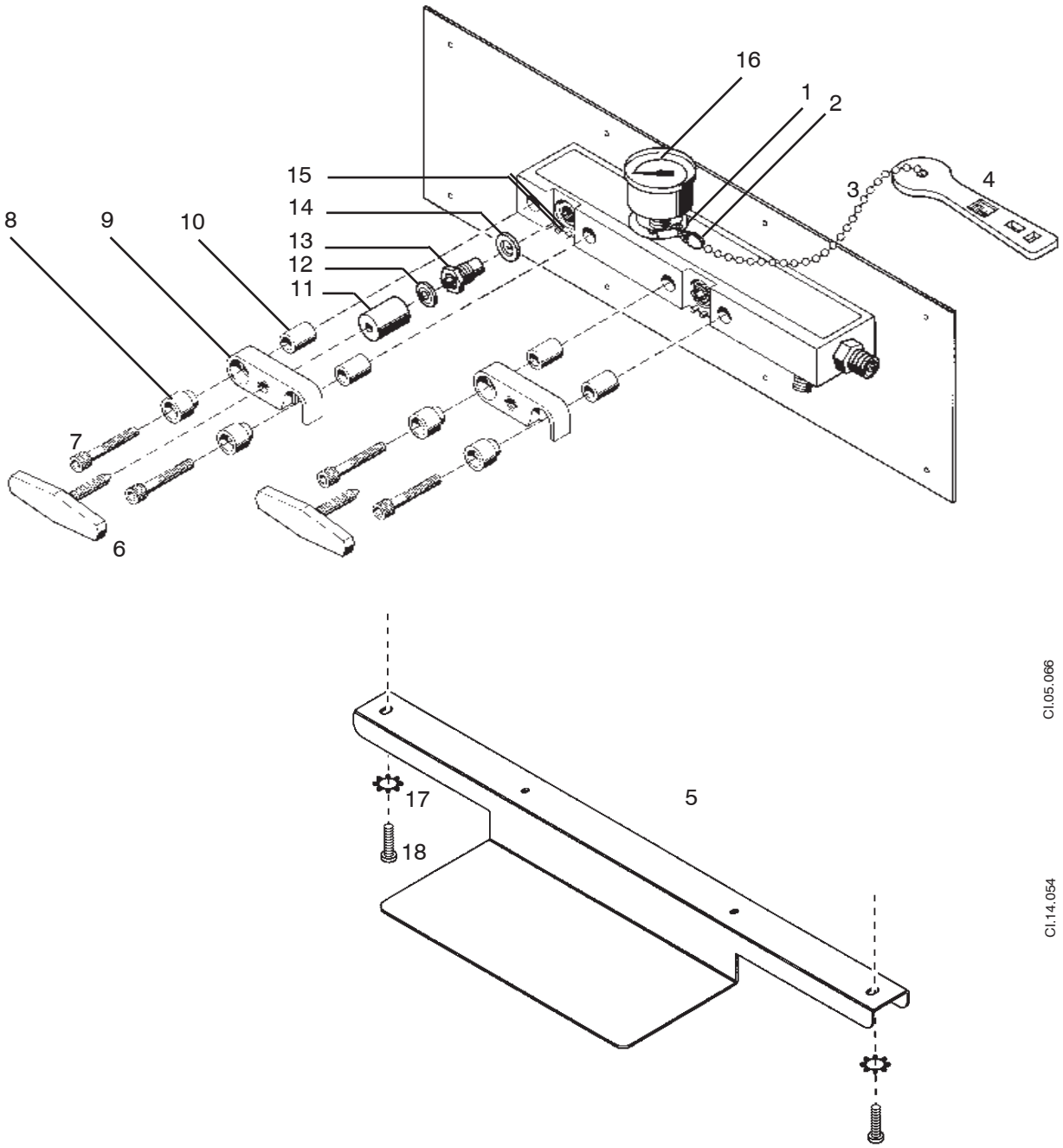
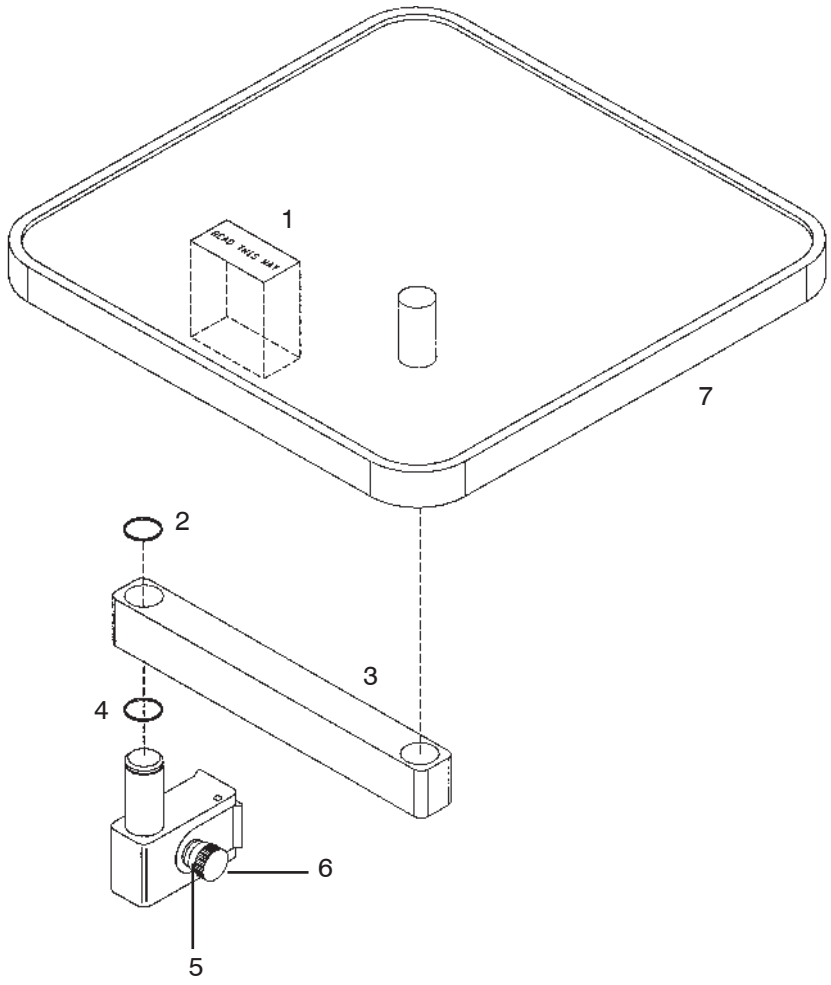


Figure 7-31
Oxygen Yoke and Regulator Assembly 2 - Manifold Block

7.32 Instrument Shelf



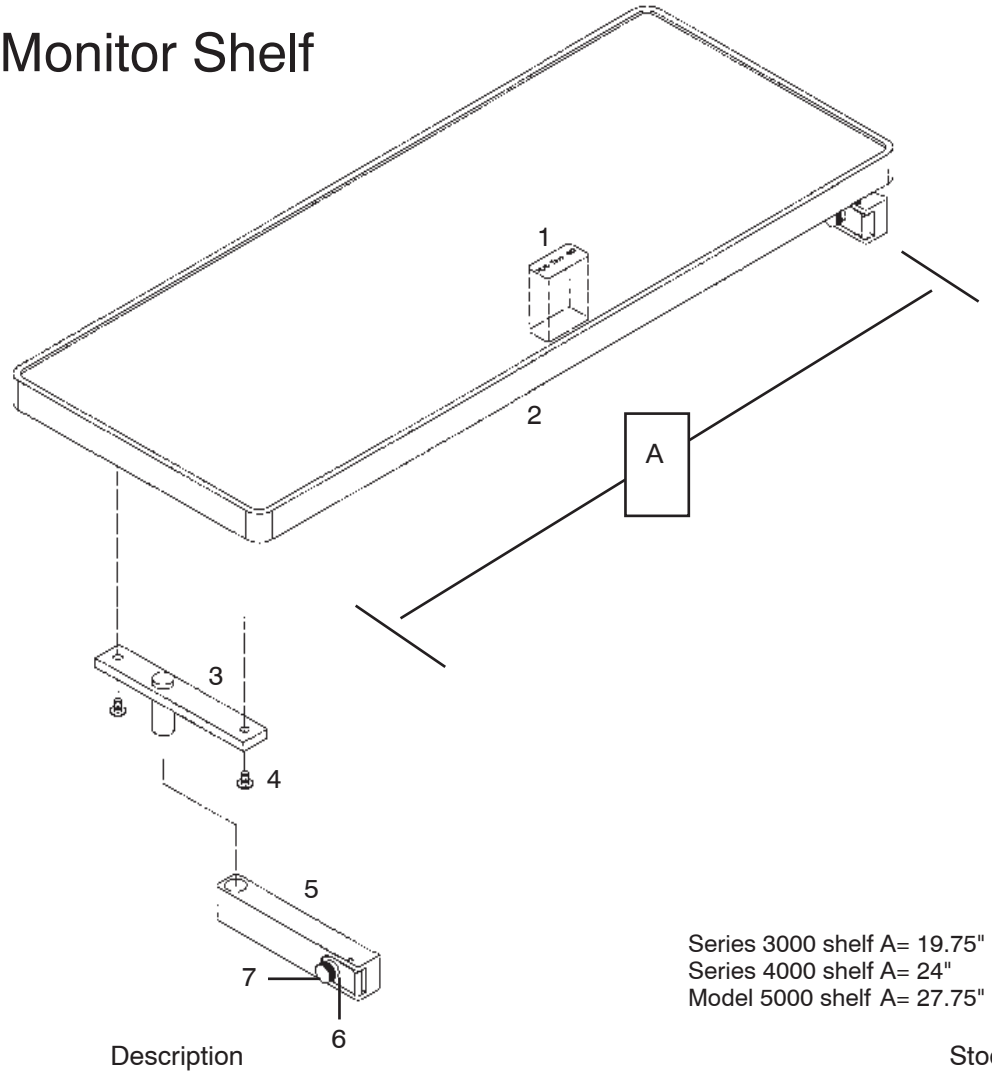
	Description	Stock Number
1.	Label, Shelf Load Limit (20 lbs)	See label section
2.	Locking Ring	0203-5186-300
3.	Swivel Arm	0217-5337-552
4.	Washer	0202-0096-300
5.	Washer	0202-0095-300
6.	Knob†	0217-5335-300
7.	Swivel Shelf, 12 x 12 (beige)*	6600-0482-500
	Swivel Shelf, 12 x 12 (light grey)*	6600-0482-501

† Apply Lubriplate (6600-0095-300) to the knob threads.

* Order item 1 when replacing shelf

Figure 7-32
Instrument Shelf, 12 x 12 (30cm x 30cm)
0217-5365-800 (beige)
6600-0513-801 (light grey)

7.33 Monitor Shelf



Series 3000 shelf A= 19.75"
Series 4000 shelf A= 24"
Model 5000 shelf A= 27.75"

	Description	Stock Number
1.	Label, Shelf Load Limit (50 lbs)	See label section
2.	Monitor Shelf 12 x 26 (beige)*	6600-0481-500
	Monitor Shelf 12 x 26 (light grey)*	6600-0481-501
	Monitor Shelf 12 x 30.5 (Model 5000)*	0217-5349-100
3.	Shelf Support	6600-0811-501
4.	Screw 1/4 -20 x 5/8*	6600-0394-400
5.	Mounting block assy.	6600-0290-800
6.	Washer (included with item 5)	0202-0095-300
7.	Knob† (included with item 5)	0217-5335-300

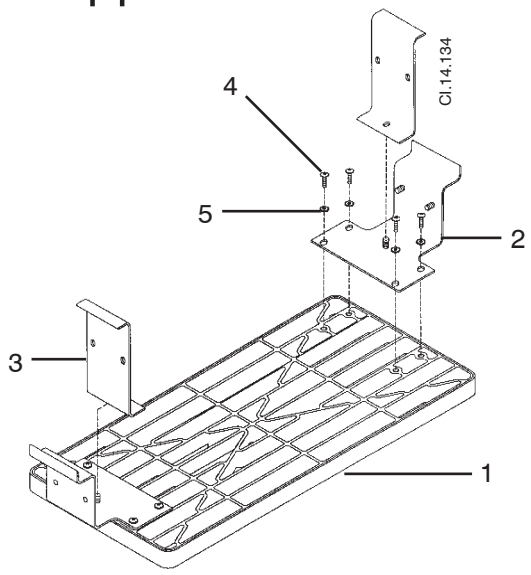
* Use Loctite 242 on threads, tighten, then loosen 1/2 turn.

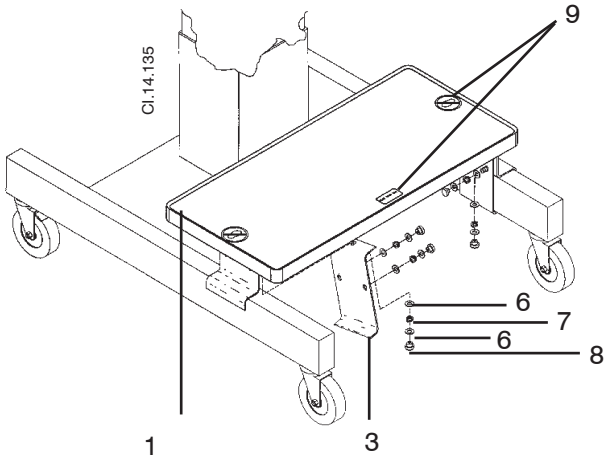
* Order item 1 when replacing shelf

† Apply Lubriplate (6600-0095-300) to the knob threads.

Figure 7-33
Monitor Shelf
Model 2001, series 3000 (beige) - 0217-5366-800
Model 2001, series 3000 (grey) - 6600-0240-801
Model 4000, 4300 and 4400 (beige) - 6600-0240-800
Series 4000, grey - 6600-0549-800
Model 5000, beige - 6600-0010-800
Model 4400, grey - 6600-0010-801

7.34 Upper bed shelf



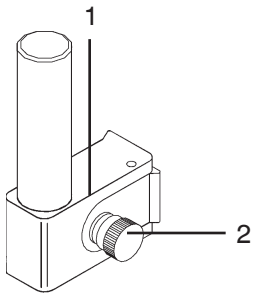


	Description	Stock Number
1.	Shelf*, 12" x 26" (beige)	6600-0481-500
	Shelf*, 12" x 26" (light grey)	6600-0481-501
2.	Upright support	6600-0695-500
3.	Bracket	6600-0694-500
4.	Screw, 1/4 - 20 x 5/8 PH	6600-0394-400
5.	Lock washer, Ext tooth	6600-0468-400
6.	Flat washer, .26 x .56x .04	0202-4526-335
7.	Lock washer, spr dbl M8 x 15.1 x 1.2	6600-0548-400
8.	Knob, 1/4 -20 insert 1.0 OD	6600-0549-400
9.	Label set	6600-1826-100

*Note: If shelf is replaced, the labels must be ordered and applied as shown in figure.

Figure 7-34
Under bed shelf
Model 4400 -6600-0497-800 (beige)
Model 4400 -6600-0497-801 (light grey)

7.35 3.5 Inch Utility Post



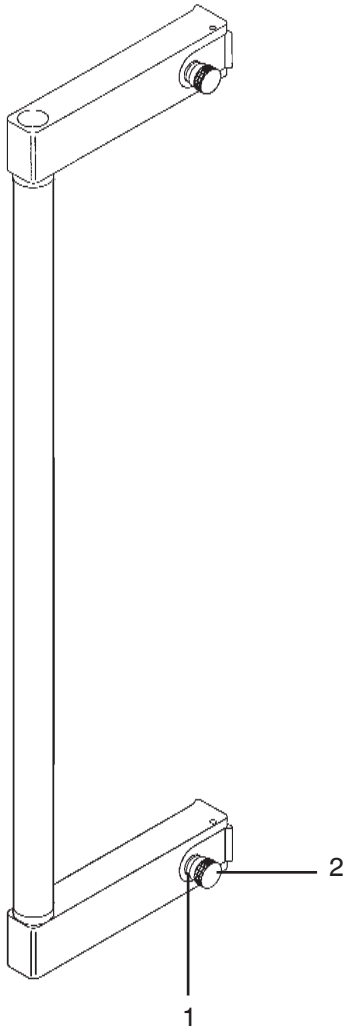
Cl.14.057

	Description	Stock Number
1.	Washer	0202-0095-300
2.	Knob†	0217-5335-300

† Apply Lubriplate (6600-0095-300) to the knob threads.

Figure 7-35
3.5 Inch (9cm) Utility Post
0217-5374-800

7.36 20 inch Utility Post



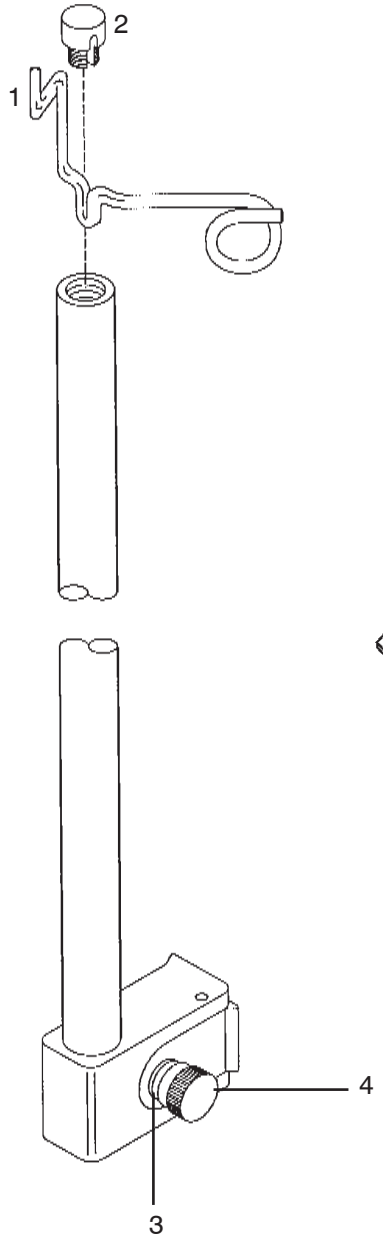
CI.14.058

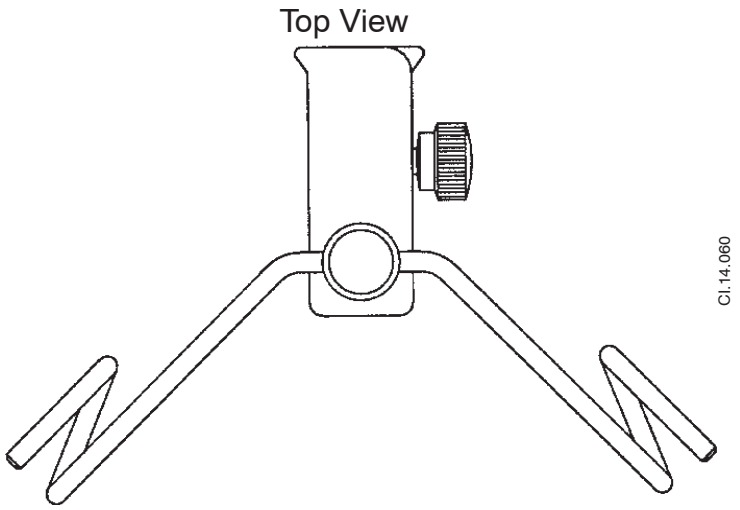
Description	Stock Number
1. Washer	0202-0095-300
2. Knob†	0217-5335-300

† Apply Lubriplate (6600-0095-300) to the knob threads.

Figure 7-36
20 inch (51cm) Utility post
0217-5376-800

7.37 I.V. Pole





Cl.14.060

Cl.14.059

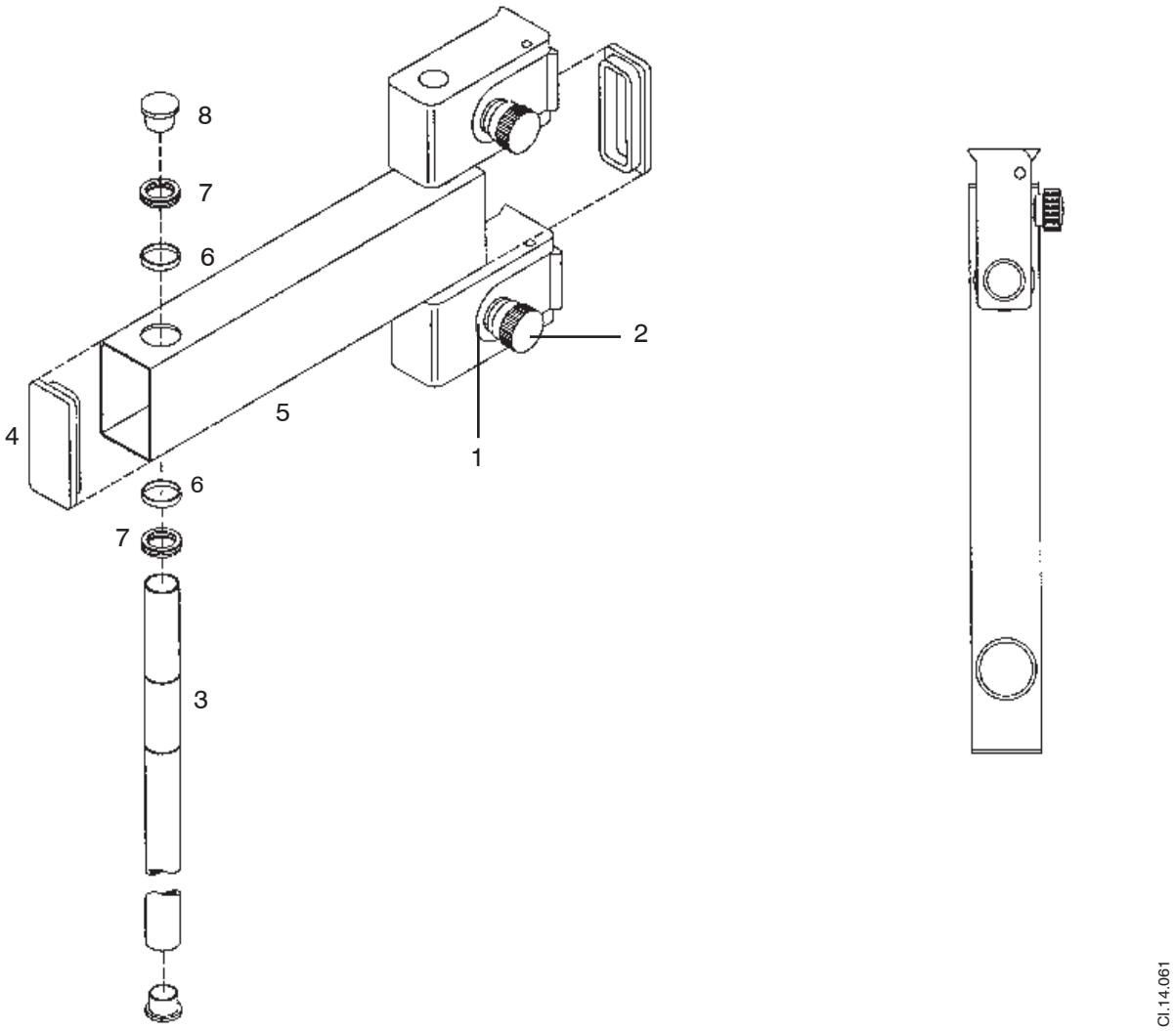
Description	Stock Number
1. Hanger	0217-5091-300
2. Cap*	0217-5092-535
3. Washer	0202-0095-300
4. Knob†	0217-5335-300

* Apply Loctite 277 before assembly.

†Apply Lubriplate (6600-0095-300) to the knob threads.

Figure 7-37
I.V. Pole
0217-5378-800

7.38 Ventilator Mounting Post



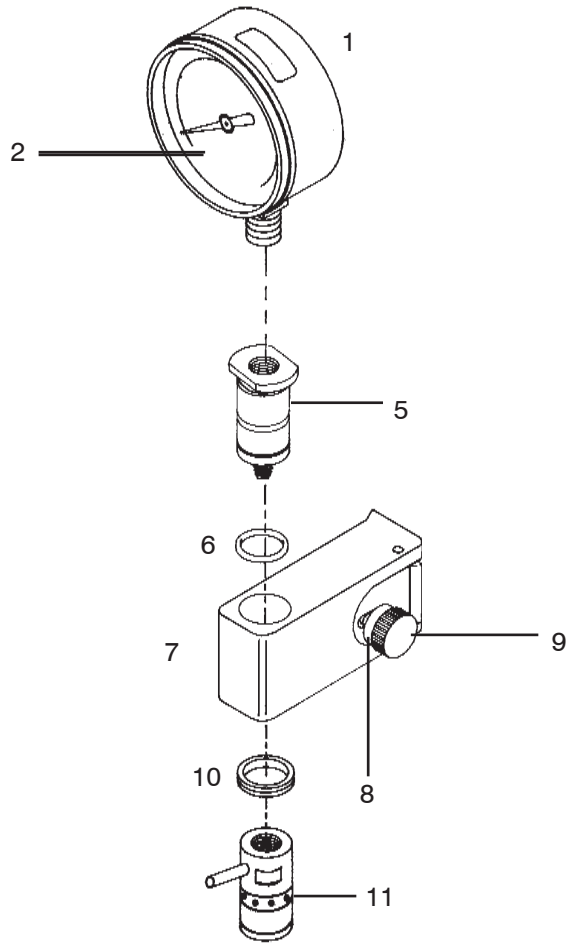
	Description	Stock Number
1.	Washer	0202-0095-300
2.	Knob†	0217-5335-300
3.	Ventilator Mounting Post Tube	0217-5288-500
4.	End Rail Cap	6600-0520-500
5.	Ventilator Mounting Post Arm	0217-5287-300
6.	Black Delrin Washer	0202-0097-500
7.	Spiral Ring Lock	0203-5188-300
8.	Black Butyrate Cap	6600-0867-500

† Apply Lubriplate (6600-0095-300) to the knob threads

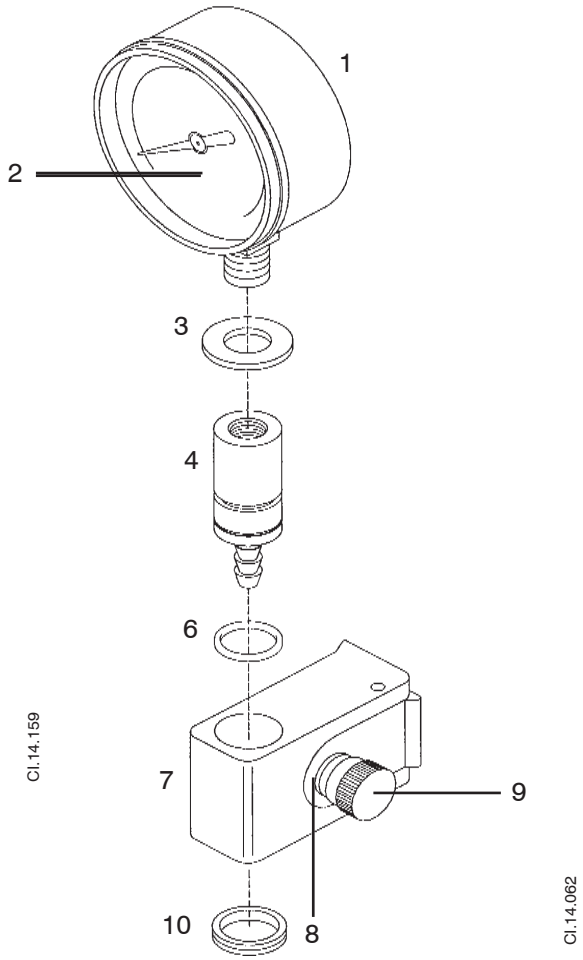
Figure 7-38
Ventilator Mounting Post
0217-5357-800

7.39 Airway Manometer

Unit with Relief Valve



Unit without Relief Valve



	Description	Stock Number
1.	Gauge Kit -20 to + 100 cm H_2O (-2 to + 10 kpa)*	M1061602
2.	Lens	M1061600
3.	Washer	0402-0221-500
4.	Coupler‡	0217-5344-542
5.	Relief valve adapter	6600-0632-400
6.	O-ring	0210-0543-300
7.	Mounting Block Assy.	6700-0080-800
8.	Washer (included with item 7)	0202-0095-300
9.	Knob† (included with item 7)	0217-5335-300
10.	Locking Ring	0203-5186-300
11.	Relief valve	6600-0633-400

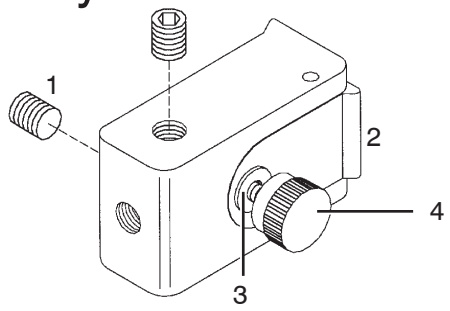
† Apply Lubriplate (6600-0095-300) to the knob threads.

* Seal pipe threads with Teflon tape.

‡ To equip old units with relief valve (item 11) replace coupler with item 5.

Figure 7-39
Airway Manometer
0217-5377-800

7.40 Manifold Assembly



CI.14.064

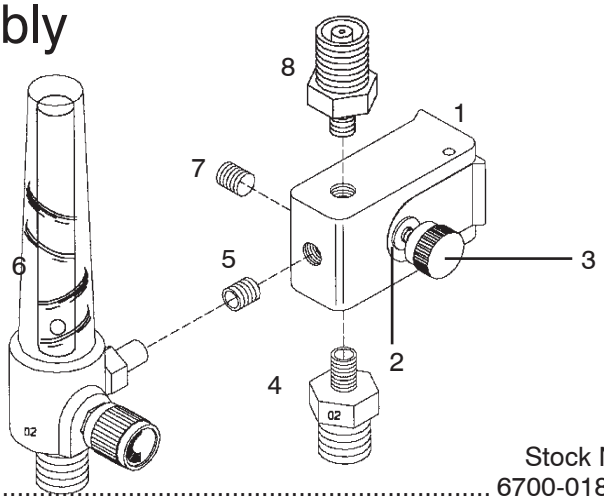
Description		Stock Number
1.	Plug 1/8 nptm w/Hex Socket*	6600-0191-400
2.	Mounting block assy.	6700-0180-700
3.	Washer (included with item 2)	0202-0095-300
4.	Knob† (included with item 2)	0217-5335-300

† Apply Lubriplate (6600-0095-300) to the knob threads.

*Seal pipe threads with Teflon tape.

Figure 7-40
Manifold Assembly
0217-5359-800

7.41 Flowmeter Assembly



CI.14.063

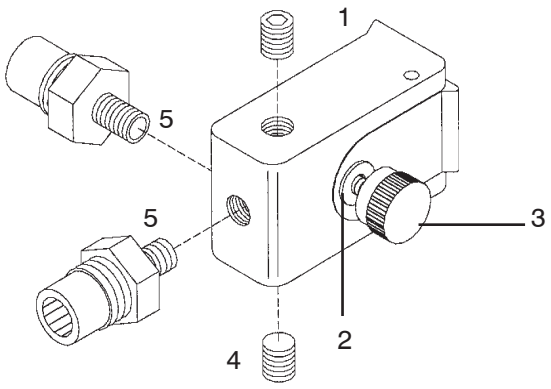
Description		Stock Number
1.	Mounting block assy.	6700-0180-700
2.	Washer (included with item 1)	0202-0095-300
3.	Knob† (included with item 1)	0217-5335-300
4.	O_2 Diss Adapter 1/8. npt	0204-0490-535
5.	Close Nipple 1/8 nptm	6700-0561-800
6.	O_2 Flowmeter (50psi)	6700-1260-907
7.	Hex Socket Plug 1/8 nptm*	6600-0191-400
8.	O_2 DISS Outlet 1/8 npt	0205-0540-800

† Apply Lubriplate (6600-0095-300) to the knob threads.

*Seal pipe threads with Teflon tape.

Figure 7-41
Flowmeter Assembly
0217-5370-800

7.42 Vacuum Manifold Assembly



CI.14.065

Description		Stock Number
1.	Mounting block assy.	6700-0180-700
2.	Washer (included with item 1)	0202-0095-300
3.	Knob† (included with item 1)	0217-5335-300
4.	Hex Socket Plug 1/8 nptm*	0413-3510-335
5.	DISS Vacuum Adapter 1/8 npt*	6700-0524-802

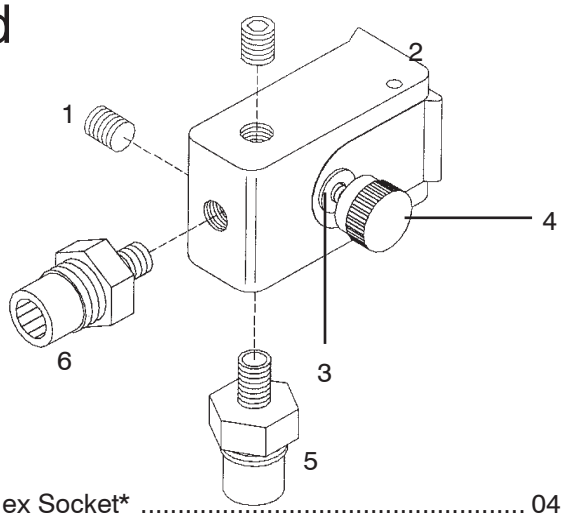
* Seal pipe threads with Teflon tape.

† Apply Lubriplate (6600-0095-300) to the knob threads.

Figure 7-42
Vacuum Manifold Assembly
(0217-5369-800)

7.43 Oxygen Manifold

Description		Stock Number
1.	Plug 1/8 nptm w/Hex Socket*	0413-3510-335
2.	Mounting Block assy.	6700-0180-700
3.	Washer (included with item 2)	0202-0095-300
4.	Knob† (included with item 2)	0217-5335-300
5.	O_2 DISS Adapter 1/8 npt*	0204-0490-535
6.	O_2 DISS Outlet 1/8 npt*	0205-0540-800



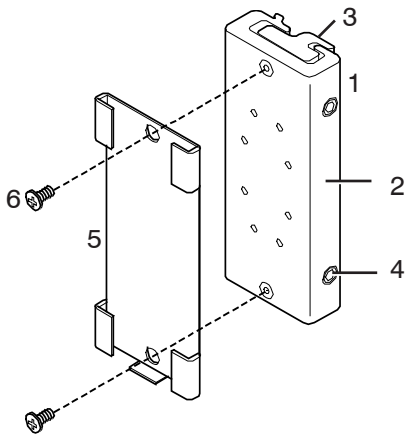
CI.14.066

† Apply Lubriplate (6600-0095-300) to the knob threads.

*Seal pipe threads with Teflon tape.

Figure 7-43
Oxygen Manifold
6600-0018-800

7.44 Slide Assembly



CI.14.068

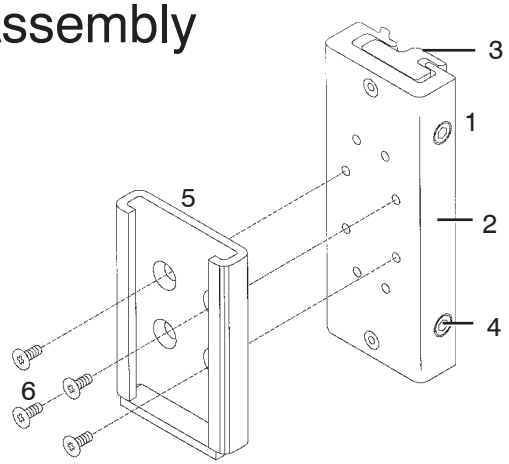
Description		Stock Number
1.	Adapter plate	0217-5363-800
2.	Housing (included w/item 1)	6600-0599-500
3.	Lock (included w/item 1)	6600-0600-500
4.	Cap head screw (included w/item 1)	6600-0441-400
5.	Vacuum Slide Bottle Mount	6600-0775-500
6.	Screw 6-32 x .238	0140-6224-104

Parts Not Shown

Allen wrench (included w/item 1)		6600-0443-400

Figure 7-44
Slide Assembly
(0217-5367-800)

7.45 Bird Dovetail Assembly



CI.14.067

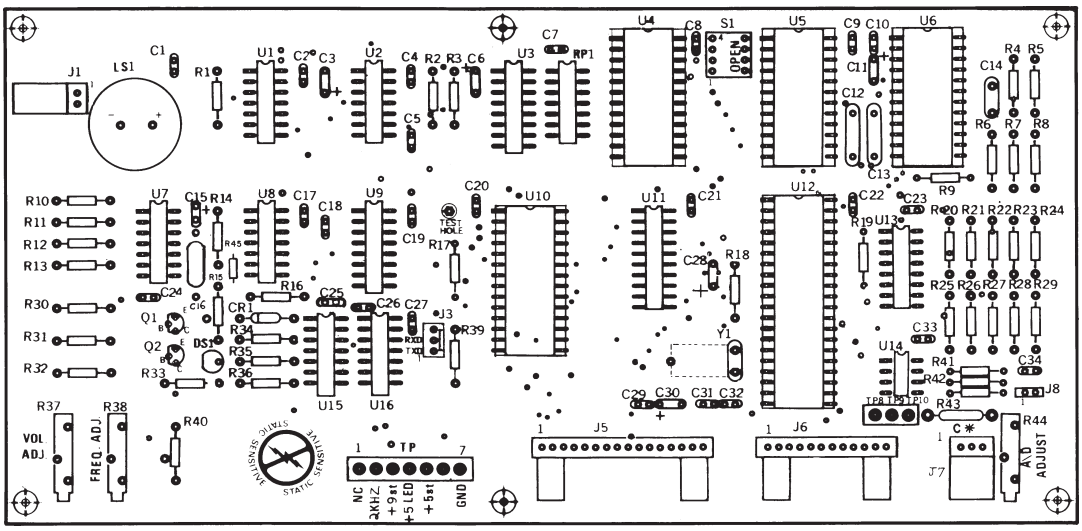
Description		Stock Number
1.	Adapter plate	0217-5363-800
2.	Housing (included w/item 1)	6600-0599-500
3.	Lock (included w/item 1)	6600-0600-500
4.	Cap head screw (included w/item 1)	6600-0441-400
5.	Female Bracket, Bird Blender	6600-0044-500
6.	Screw	6600-0014-400

Parts Not Shown

Allen wrench (included w/item 1)		6600-0443-400

Figure 7-45
Bird Dovetail Assembly
(6600-0031-900)

7.46 Control Board Layout



CI.05.059

S1	**Switch. Dip 4 ckt**
TP1-TP7	**Header 7 Pin**
TP8 9 10	**Header 3 pin**
U1	**IC 74LS74** **Dual D Flip Flop Pos Edge**
U2	**IC 74LS08** **Quad 2 Input and**
U3	**IC 74LS123** **Dual One Shot w/Clear**
U4 5	**IC 8243** **Input/Output Expander**
U6	**IC ADC3711 A/D Converter**
U7	**IC 7556 Dual 555 Timer**
U8	**IC 74LS132** **Quad 2 Input Schmitt Nand**
U9	**IC 4020B CMOS** **14 Bit Binary Counter**
U10	**IC 27128 EPROM** **6600-0190-800** **Programmed**
U11	**IC 74LS373** **Octal D Latch 3 State Out**
U12	**IC 8031 Microprocessor**
U13	**IC 4051B CMOS** **8 channel Analog MPX**
U14	**IC LM10 Voltage Reference**
For U4 5 6	**Socket IC 24 Pin**
For U10	**Socket IC 28 Pin**
For U12	**Socket IC 40 Pin**
Y1	**Cyrstal 6 MHz HC-18/U**

Note: The following parts, as shown on the silkscreen, are not installed on this assembly.
U15, U16, C25, C27, J3, J8, and CR2.

Note: R45 and R16 not installed on earlier boards.

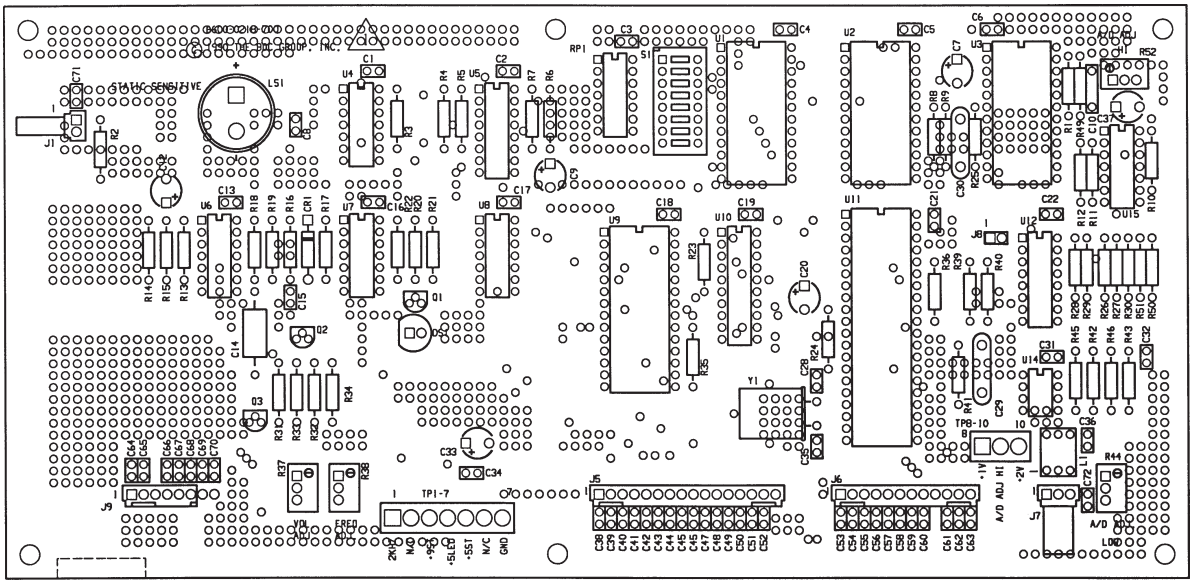
Figure 7-46
Control Board Layout
Units with software revision prior to 04.01

Symbol	Description
C1 2 4 5 7 8 9 10 17 18 19 20 21 22 23 24 29 33 34	Capacitor .1 µF 50 V 20% Ceramic
C3 6 11 28 30	Capacitor 15 µF 16 V 20% Tantalum
C12 13	Capacitor .27 µF 100 V 10% Polyester
C14	Capacitor 220 pF 1000 V 10%
C15	Capacitor 10 µF 20 V 10% Tantalum
C16	Capacitor .01 µF 100 V 10% Polypropylene
C31 32	Capacitor 33 pF 100 V 5% Ceramic
CR1	Diode IN4001
DS1	Diode LED Red HLMP 3366
J6	Header 12 ckt
J5	Header 16 ckt
J7	Header 3 ckt
J1	Header 2 ckt
LS1*	Audio Alarm 12 V
Q1 2	Transistor MPS6515 NPN
R1 33	Resistor 47k 1/4 W 5% Carbon Film
R2	Resistor 220k 1/4 W 5% Carbon Film
R3	Resistor 39k 1/4 W 5% Carbon Film
R4	Resistor 6.8k 1/4 W 5% Carbon Film
R5 17 19 36 39	Resistor 200Ω 1/4 W 5% Carbon Film
R6 20 21 22 23 25 28	Resistor 5.76k 1/8 W 0.1% Metal Film
R7 8 26	Resistor 10K 1/8 W 0.1% Metal Film
R9 41	Resistor 100k 1/4 W 1% Metal Film
R10 11 14 18 29 30 34	Resistor 10k 1/4 W 5% Carbon Film
R12 15	Resistor 4.7k 1/4 W 5% Carbon Film
R13	Resistor 1 meg 1/4 W 5% Carbon Film
R16	Resistor 1k 1/4 W 5% Carbon Film
R24	Resistor 2.21k 1/8 W 0.1% Metal Film
R27	Resistor 220 ohm 1/4 W 5% Carbon Film
R31	Resistor 33k 1/4 W 5% Carbon Film
R32	Resistor 51 ohm 1/4 W 5% Carbon Film
R35	Resistor 510 ohm 1/4 W 5% Carbon Film
R44	Resistor var 500 ohm 3/4 W 10% 20 Turn
R38	Resistor var 10k 3006p-1-103
R40	Resistor 75k 1/4 W 1% Metal Film
R42	Resistor 453k 1/8 W 0.1% Metal Film
R43	Resistor 5.9k 1/4 W 0.1% Metal Film
R45	Resistor 2.7k 1/4 W 5%
RP1	Resistor Network 10k

* R37 Resistor VAR 500 ohm 10% when LS1 is 1" tall

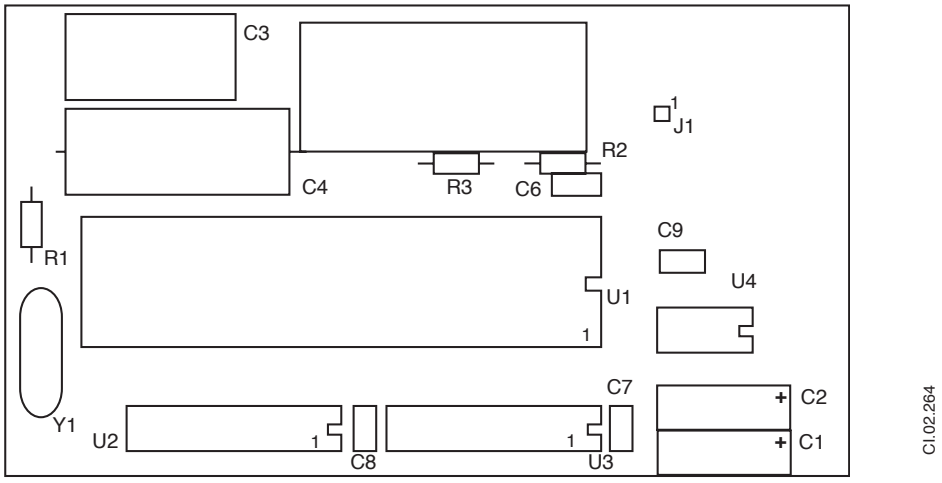
R37 Resistor VAR 2000 ohm 10% when LS1 is ½" tall

7.47 Control Board Layout



Note: Some software 04.00 boards do not have connector J9 shown above.

On Control boards with a A/D Module daughter board, the A/D module is installed a U3. The following components are not installed: C7, C10, C29, R1, R9 R40 and R41



Note: Daughter board shown solder side up.

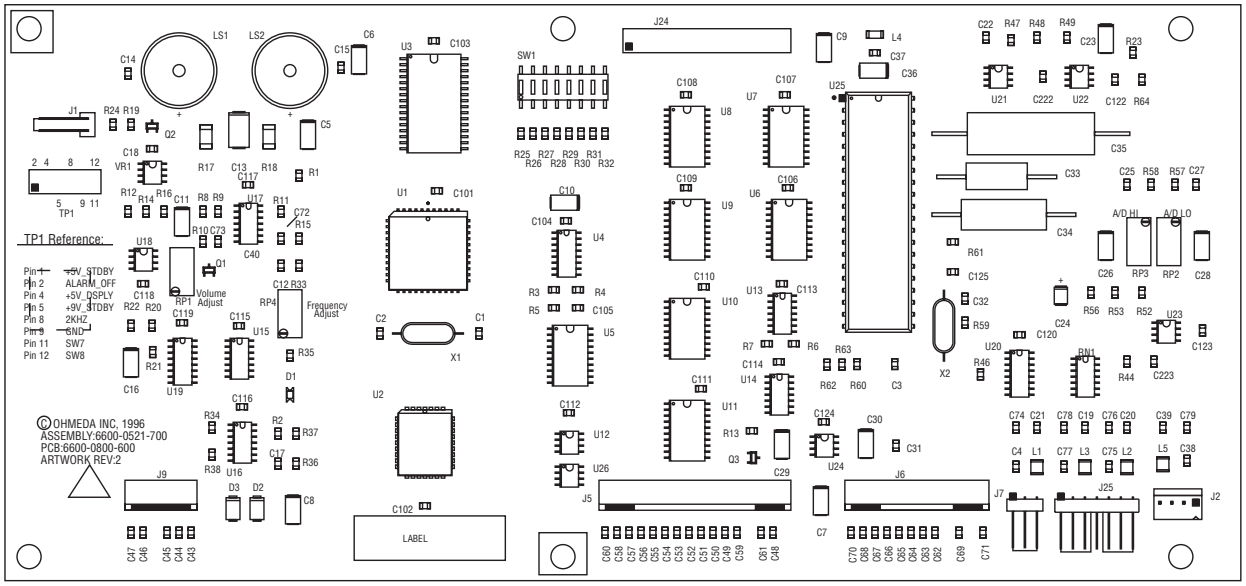
Figure 7-47
Control Board Layout
Units with software revision 4.00 through 05.10

DESCRIPTION	QTY	SYMBOL
SOCKET, 40 PIN	1	FOR U11
SOCKET, 28 PIN	1	FOR U9
HEADER, 7 PIN	1	TP1-7
HEADER, 3 PIN	1	TP8-10
HEADER, STRAIGHT 16 PIN	1	J5
HEADER, STRAIGHT 12 PIN	1	J6
HEADER, RTANG, 3 PIN	1	J7
HEADER, RTANG, 2 PIN	1	J1
HEADER, STRAIGHT 6 PIN	1	J9
SWITCH, DIP 8 POSITION	1	S1
LED HLMP-3366	1	DS1
ALARM	1	LS1
FILTER, EMI DATA LINE	1	L1
IC 74LS02	1	U8
IC 74LS123	1	U5
IC 74LS04	1	U4
IC 27128 PROGRAMMED V0.500	1	U9
IC 74LS373	1	U10
IC 8243	2	U1, 2
IC IN8032	1	U11
IC 4051B	1	U12
IC ADC3711	1	U3
IC LM10	1	U14
IC 7556	1	U6
IC 74LS132	1	U7
IC LM324	1	U15
CRYSTAL 6.0 MHz	1	Y1
TRANSISTOR MPS6515	2	Q1, 2
DIODE	1	CR1
CAPACITOR .01 MFD	1	C14
CAPACITOR 15 MFD	3	C7, 9, 20
CAPACITOR .27 MFD	2	C29, 30
CAPACITOR 10 MFD 10%	2	C12, 33
CAPACITOR 220 pF	1	C10
CAPACITOR 33 pF	37	C28, 35, 38-72
CAPACITOR 0.1 MFD	20	C1-6,8,13,15-19,21
		22,31,32,34,36
CAPACITOR 1 MFD	1	C37
RESISTOR 1K 0.1%	1	R49
RESISTOR PC 10K	1	RP1
RESISTOR VAR 500	2	R37, 44
RESISTOR 1 MEG 5%	1	R14
RESISTOR 47K 5%	1	R20
RESISTOR 100K 0.1%	5	R11,12,41,50,51
RESISTOR 200 5%	6	R7,9,23,35,36,39
RESISTOR 4.81K 0.1%	1	R46
RESISTOR 10K 5%	11	R2-5, 8, 13, 17,
		R18, 22, 24, 34
RESISTOR 267K 0.1%	1	R40
RESISTOR 33K 5%	2	R6, 32
RESISTOR 2.21K 0.1%	1	R42
RESISTOR 10K 0.1%	2	R29, 45
RESISTOR 5.76K 0.1%	4	R26-28, 30
RESISTOR 75K 1%	2	R15, 25
RESISTOR 1K 5%	2	R16, 19
RESISTOR 510 5%	1	R21
RESISTOR 51 5%	1	R33
RESISTOR 6.8K 5%	1	R1
RESISTOR VAR 20K	1	R38
RESISTOR 215 1%	1	R10
RESISTOR POTENTIOMETER, 20 OHMS	1	R52
RESISTOR 5.9K 0.1%	1	R43

6600-0002-850

CI.14.070

7.48 SMT Control Board Layout



CI.14.183

Figure 7-48
SMT Control Board Layout
Units with software revision 06.00 and higher

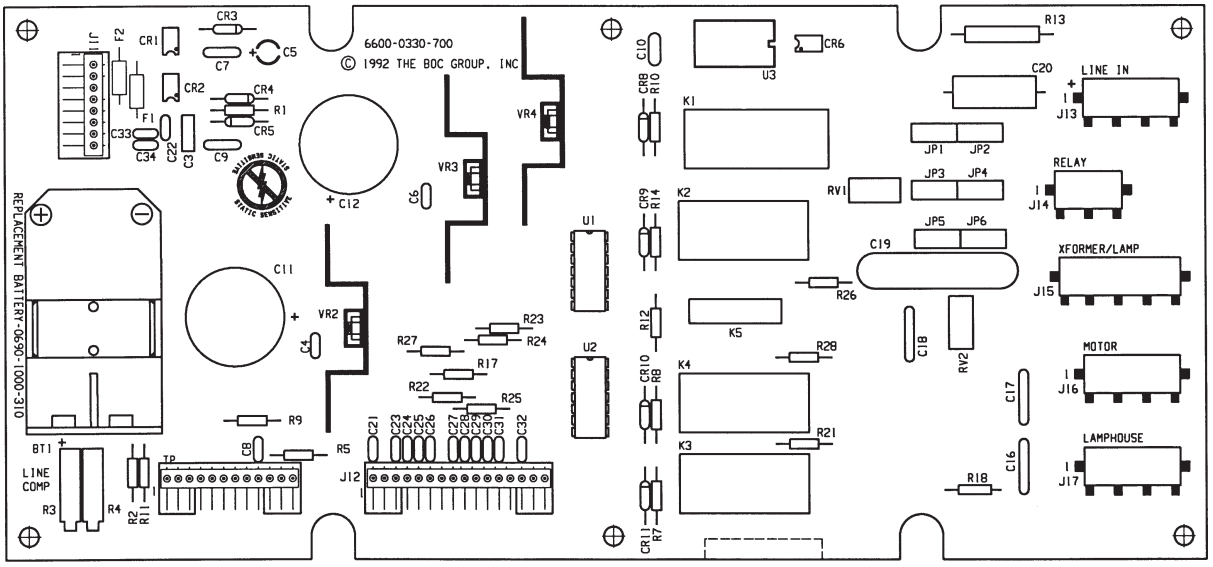
6600-0609-625	RESISTOR, 470, 5%, 0805 SMT	1	R35	14
6600-0609-661	RESISTOR, 22K, 5%, 0805 SMT	1	R33	14
6600-0609-601	RESISTOR, 0, 5%, 0805 SMT	1	R60	14
6600-0609-667	RESISTOR, 33K, 5%, 0805 SMT	1	R22	14
6600-0609-647	RESISTOR, 4.7K, 5%, 0805 SMT	14	R20,R21,R25-R32,R36-R38, R62	14
6600-0641-609	RESISTOR, 47, 5%, 2010 SMT	1	R17	14
6600-0609-635	RESISTOR, 1.5K, 5%, 0805 SMT	1	R16	14
6600-0609-682	RESISTOR, 130K, 5%, 0805 SMT	1	R14	14
6600-0609-638	RESISTOR, 2K, 5%, 0805 SMT	1	R19	14
6600-0609-613	RESISTOR, 100, 5%, 0805 SMT	1	R12	14
6600-0609-643	RESISTOR, 3.3K, 5%, 0805 SMT	1	R10	14
6600-0610-663	RESISTOR, 21.5K, 1%, 0805 SMT	1	R9	14
6600-0610-654	RESISTOR, 9.31K, 1%, 0805 SMT	1	R8	14
6600-0609-631	RESISTOR, 1K, 5%, 0805 SMT	7	R3-R5,R7,R13,R46,R63	14
6600-0609-655	RESISTOR, 10K, 5%, 0805 SMT	4	R1,R2,R11,R24	14
6600-0804-600	TRANSISTOR, NPN,MMBT4401	1	Q2	14
6600-0661-600	TRANSISTOR, NPN,MMBT3904	2	Q1,Q3	14
0690-1100-306	AUDIO TRANSDUCER	1	LS1	6,14
6600-0635-600	FERRITE BEAD	1	L4	14
6600-0660-601	INDUCTOR, 4.7UH	1	L1	14
6600-0659-614	HEADER, 2X14 PINS	1	J24	14
6600-0336-606	CONNECTOR, 6PIN	1	J9	14
6600-0340-603	CONNECTOR, 3PIN	1	J7	14
6600-0337-612	CONNECTOR, 12PIN	1	J6	14
6600-0337-616	CONNECTOR, 16PIN	1	J5	14
6600-0340-602	CONNECTOR, 2PIN	1	J1	14
6600-0615-601	DIODE, S1A	2	D2, D3	14
6600-0656-600	LED, PR1101 SMT	1	D1	14
6600-0803-613	CAPACITOR, .01UF, 5%, 1812, SMT	1	C40	14
6600-0570-600	CAPACITOR, 1UF, 10%	1	C35	14
6600-0569-600	CAPACITOR, 0.33UF, 10%	1	C34	14
6600-0568-600	CAPACITOR, 0.15UF, 10%	1	C33	14
6600-0637-601	CAPACITOR, 3.3UF, 20%, 3528, SMT	1	C24	14
6600-0603-601	CAPACITOR, 10UF, 20%, 6032, SMT	6	C23,C26,C28-C30,C36	14
6600-0618-603	CAPACITOR, 47UF, 20%, 7343, SMT	1	C13	14
6600-0802-610	CAPACITOR, 1800PF, 5%, 0805, SMT	1	C12	14
6600-0678-604	CAPACITOR, 33UF, 20%, 6032, SMT	1	C11	14
6600-0651-603	CAPACITOR, 15UF, 20%, 6032, SMT	7	C5-C10,C16	14
6600-0602-625	CAPACITOR, 0.1UF, 20%, 0805, SMT	35	C3,C14,C17,C18,C21,C22, C25,C27,C31,C37,C72, C73,C101,C102,C104-C111, C113-C117,C119,C120, C122-C125,C222,C223	14
6600-0600-614	CAPACITOR, 33PF, 10%, 0805, SMT	30	C1,C2,C4,C43,C44,C46, C47,C49-C52,C54-C71,C74	14
6600-0800-600	PC BOARD BLANK	1		
6600-1045-100	LOT/SERIAL NUMBERING SPEC	REF		8
6600-1027-100	ESD SENSITIVE DEVICE HNDL/PKG STD	REF		1,15
6600-2201-100	TEST SPECIFICATION	REF		9
6600-2199-100	FUNCTIONAL DESCRIPTION	REF		
6600-2202-100	SCHEMATIC	REF		
PART NUMBER	DESCRIPTION	QTY	REFERENCE DESIGNATOR	NOTES

CI.14.184

6600-0673-601	SOCKET, 32PIN PLCC	1	XU2	14
6600-0650-600	CRYSTAL, 3.579MHZ, SMT	1	X2	14
6600-0648-600	CRYSTAL, 6MHZ, SMT	1	X1	14
6600-0662-600	VOLTAGE REGULATOR, LM317L	1	VR1	14
6600-0563-600	ADC, 12 BIT ICL7109	1	U25	14
6600-0645-600	DC-DC INVERTER, ICL7660	1	U24	14
6600-0634-600	OP AMP LF411	2	U22, U23	14
6600-0654-600	BANDGAP REFERENCE LM385	1	U21	14
6600-0626-600	ANALOG MUX, 8 TO 1, 74HC4051	1	U20	14
6600-0674-600	DUAL ONE SHOT 74HC123A	1	U19	14
6600-0621-600	DUAL TIMER 556	1	U17	14
6600-0666-600	NAND, SCHMITT TRIGGER, 74HC132	1	U16	14
6600-0671-600	QUAD NOR GATE 74HC02	1	U15	14
6600-0670-600	QUAD OR GATE 74HC32	2	U13,U14	14
6600-0814-600	LATCH WITH CLEAR, 74HC273	2	U10,U11	14
6600-0668-600	BIDIRECTIONAL BUFFER, 74HC245	4	U6-U9	14
6600-0667-600	LATCH, TRANSPARENT, 74HC373	1	U5	14
6600-0664-600	DECODER, 3 TO 8 74HC138	1	U4	14
6600-0799-600	EPROM, PROGRAMMED	1	U2	17
6600-0629-600	MICROCONTROLLER, PLCC 8032	1	U1	14
6600-0659-606	HEADER, 2X6 PIN	1	TP1	14
6600-0676-600	DIP SWITCH, SMT	1	SW1	14,16
6600-0351-611	POTENTIOMETER, MULTI-TURN, 20K	1	RP4	14
6600-0351-606	POTENTIOMETER, MULTI-TURN, 500 ohm	2	RP2,RP3	14
6600-0351-610	POTENTIOMETER, MULTI-TURN, 10K	1	RP1	14
6600-0627-601	RESISTOR, NETWORK, 5.76K, 0.10%	1	RN1	14
6600-0609-602	RESISTOR, 10, 5%, 0805 SMT	1	R64	14
6600-0610-670	RESISTOR, 42.2K, 1%, 0805 SMT	1	R61	14
6600-0610-631	RESISTOR, 1K, 1%, 0805 SMT	2	R57,R58	14
6600-0610-636	RESISTOR, 1.65K, 1%, 0805 SMT	1	R53	14
6600-0610-641	RESISTOR, 2.55K, 1%, 0805 SMT	1	R52	14
6600-0610-671	RESISTOR, 43.2K, 1%, 0805 SMT	1	R49	14
6600-0610-655	RESISTOR, 10K, 1%, 0805 SMT	1	R48	14
6600-0609-651	RESISTOR, 6.8K, 5%, 0805 SMT	2	R47,R56	14
6600-0611-672	RESISTOR, 10K, 0.1%, 0805 SMT	1	R44	14
PART NUMBER	DESCRIPTION	QTY	REFERENCE DESIGNATOR	NOTES

CI.14.185

7.49 Power Supply Board Layout Common controller - Units w/HCA Serial No.



Description	Jumper Configuration JP1 2 3 4 5 6	Part Number
Service board, units with HCA serial#	Y N Y N Y N	6600-0012-850
Service board, IWS 5000 units without HCA serial#	N Y N Y N Y	6600-0182-700

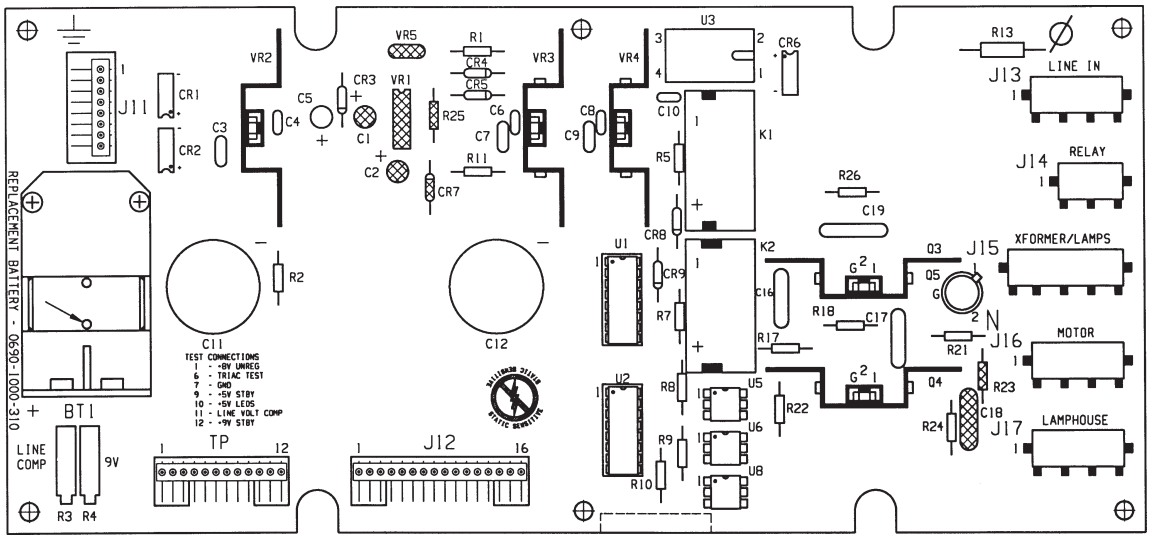
Note: Use Thermacote thermal joint compound (0220-5255-300) between components VR2, VR3 and VR4 and their respective heatsinks.

Figure 7-49
Power Supply Board Layout
Common controller
Units with HCA and HCC serial numbers

DESCRIPTION	QTY	SYMBOL
RESISTOR, 330, 5%, 1/4W	1	R12
TEST PROCEDURE FUNCTIONAL		
ESD SENSITIVE DEVICE HNDL/PKG STD		
LOT NUMBERING SPECIFICATION		
FUNCTIONAL DESCRIPTION		
SCHEMATIC		
PC BOARD, BLANK	1	
THERMACOTE		
4-40 X 1/4 SCREW	2	H1
4-40 NUT, SLFLCKING ELASTIC	3	H4
NO.4 LOCKWASHER	2	H2
4-40 HEX NUT	2	H3
CONN, HEADER, 3 SOCKET, 350825-1	1	J17
CONN, HEADER, 3 PIN, 350789-1	2	J13, J16
CONN, HEADER, 4 PIN, 350792-1	1	J15
CONN, HEADER, 2 PIN, 350786-1	1	J14
CONN, HEADER, 16 PIN, 1100-9-116-01	1	J12
CONN, HEADER, 12 PIN, 1100-9-112-01	1	TP
CONN, HEADER, 8 PIN, 1100-9-108-01	1	J11
FUSE, 2A	2	F1, F2
HEAT SINK, 6070B SF-1 MT	3	H5
BATTERY HOLDER	1	FOR BT1
IC, OPTO CYN65	1	U3
IC, MP06426	2	U1,U2
RELAY 8A E3207-00-102 EICHHOFF	1	K2
RELAY SS 16 PIN DIP	1	K5
RELAY 16A, 250V	2	K3, 4
RELAY 16A, 250V (ALTERNATE)	2	K3, 4
IC LINEAR 7805C	3	VR2,VR3,VR4
DIODE BRIDGE 50V 1A	3	CR1,CR2,CR6
RELAY 20A E3209-00-307	1	K1
DIODE VSK120	1	CR4
DIODE IN4001	6	CR3,5,8,9,10,11
CAPACITOR, .33 MFD	1	C20
CAPACITOR, .47 MFD	1	C10
CAPACITOR, 4700 MFD, 35V	2	C11,C12
CAPACITOR, 15 MFD, 35V, 20%	1	C5
CAPACITOR, .33 MFD, 50V	3	C3,C7,C9
CAPACITOR, 0.1 MFD, 50V, 20%	3	C4,C6,C8
CAPACITOR, .01 MFD, 250V RMS	3	C16,C17,C18
CAPACITOR, .33 MFD, 600V	1	C19
RESISTOR, 56 5% 1/4W	1	R10
RESISTOR, VAR 10K	1	R3
RESISTOR, VAR 1K	1	R4
RESISTOR, 47K, 5%, 2W	1	R13
RESISTOR, 100K, 5%, 1/4W	1	R5
RESISTOR, 47, 5%, 1/4W	1	R28
RESISTOR, 470, 5%, 1/4W	1	R11
RESISTOR, 180, 5%, 1/4W	1	R9
RESISTOR, 3K, 5%, 1/4W	6	R17,22,23,24,25,27
RESISTOR, 100, 5%, 1/4W	2	R1,14
RESISTOR, 22, 5%, 1/4W	2	R18,21
RESISTOR, 100K, 1%, 1/4W	1	R2
RESISTOR, 10, 5%, 1/4W	1	R26
RESISTOR, 18, 5%, 1W	2	R7, 8
RESISTOR, 22, 5%, 1W (ALTERNATE)	2	R7, 8
VARISTOR, 320V AC	1	RV1

CI.14.073

7.50 Power Supply Board Layout Model 5000 115/220/240 V



Note: Use Thermacote thermal joint compound (0220-5255-300) between components VR2, VR3 and VR4 and their respective heatsinks.

Figure 7-50
Power Supply Board Layout
Model 5000 115/220/240 V
Units with AAN serial numbers

Parts Legend for Power Supply Board 115 V

Symbol	Description
B1	Battery, 9 Volt Rechargeable
C3 7 9	Capacitor .33 µf 50V 20% Ceramic
C4 6 8	Capacitor .1 µf 50V 20% Ceramic
C5	Capacitor 15 µf 16V 20% Tantalum
C10	Capacitor .47 µf 50V 20% Ceramic
C11 12	Capacitor 4700 µf 16V 20% Electrolytic
C16 17	Capacitor .01 µf 1000V 20% Ceramic
C19	Capacitor .33 µf
CR1 2 6	Diode Bridge VM08
CR3 5 8	Diode IN4001
CR4	Diode Shottky VSK120
H1	Screw, 4-40 × ¼
H2	Lock-Washer int #4
H3	Hex Nut 4-40
H4	Nut Elast 4-40
H5	Heat Sink
For BT1	Battery Holder, 9 Volt
J11	Header 8 Pin
J12	Header 16 Pin
J13 16	Header 3 Pin
J14	Header 2 Pin
J15	Header 4 Socket
J17	Header 3 Socket
K1 2	Relay 9Vdc DPST
Q3 4	Triac MAC15A-8
Q5	IC T2300 Zero Crossing Triac
For Q5	Transistor Pad T0 5 Case
R1	Resistor 100 Ω ¼w 5% Carbon Film
R2	Resistor 100k ¼w 1% Metal Film
R3	Resistor var 10k 3006p-1-103
R4	Resistor var 1k 3006-p-103
R5	Resistor 100k ¼w 5% Carbon Film
R7 8 10	Resistor 510 Ω ¼w 5% Carbon Film
R9	Resistor 180 Ω ¼w 5% Carbon Composition
R11	Resistor 470 Ω ¼w 5% Carbon Film
R17 22 24	Resistor 150 Ω ¼w 5% Carbon Film
R13	Resistor 47K 2w 5% Carbon Composition
R18 21	Resistor 22 Ω ¼w 5% Carbon Composition
R26	Resistor 10 Ω ¼w 5% Carbon Composition
TP	Header 12 Pin
U1 2	IC VQ1000 CJ VMOS Power FET 6600-0176-800
U3	IC CNY65 Optoisolator
U5 6 8	IC 3022 Photo Triac Driver
VR2 3 4	IC 7805C Voltage Regulator 5V

Parts Legend for Power Supply Board 220/240 V

Symbol	Description
B1	Battery, 9 Volt Rechargeable
C3 7 9	Capacitor .33 µf 50V 20% Ceramic
C4 6 8	Capacitor .1 µf 50V 20% Ceramic
C5	Capacitor 15 µf 16V 20% Tantalum
C10	Capacitor .47 µf 50V 20% Ceramic
C11 12	Capacitor 4700 µf 16V 20% Electrolytic
C16 17	Capacitor .01 µf 1000V 20% Ceramic
C19	Capacitor .33 µf
CR1 2 6	Diode Bridge VM08
CR3 5 8	Diode IN4001
CR4	Diode Shottky VSK120
H1	Screw, 4-40 × ¼
H2	Lock-Washer int #4
H3	Hex Nut 4-40
H4	Nut Elast 4-40
H5	Heat Sink
For BT1	Battery Holder, 9 Volt
J11	Header 8 Pin
J12	Header 16 Pin
J13 16	Header 3 Pin
J14	Header 2 Pin
J15	Header 4 Socket
J17	Header 3 Socket
K1 2	Relay 9Vdc DPST
Q3 4	Triac MAC15A-10
Q5	IC T2300 Zero Crossing Triac
For Q5	Transistor Pad T0 5 Case
R1	Resistor 100 Ω ¼w 5% Carbon Film
R2	Resistor 100k ¼w 1% Metal Film
R3	Resistor var 10k 3006p-1-103
R4	Resistor var 1k 3006-p-103
R5	Resistor 100k ¼w 5% Carbon Film
R7 8 10	Resistor 510 Ω ¼w 5% Carbon Film
R9	Resistor 180 Ω ¼w 5% Carbon Composition
R11	Resistor 470 Ω ¼w 5% Carbon Film
R17 22 24	Resistor 150 Ω ¼w 5% Carbon Film
R13	Resistor 47K 2w 5% Carbon Composition
R18 21	Resistor 22 Ω ¼w 5% Carbon Composition
R26	Resistor 10 Ω ¼w 5% Carbon Composition
TP	Header 12 Pin
U1 2	IC VQ1000 CJ VMOS Power FET 6600-0176-800
U3	IC CNY65 Optoisolator
U5 6	IC IL420 Tested
U8	IC 3022 Photo Triac Driver
VR2 3 4	IC 7805C Voltage Regulator 5V

CI.14.194

7.51 Power Supply Board Layout Common controller - Units w/HCA Serial No.

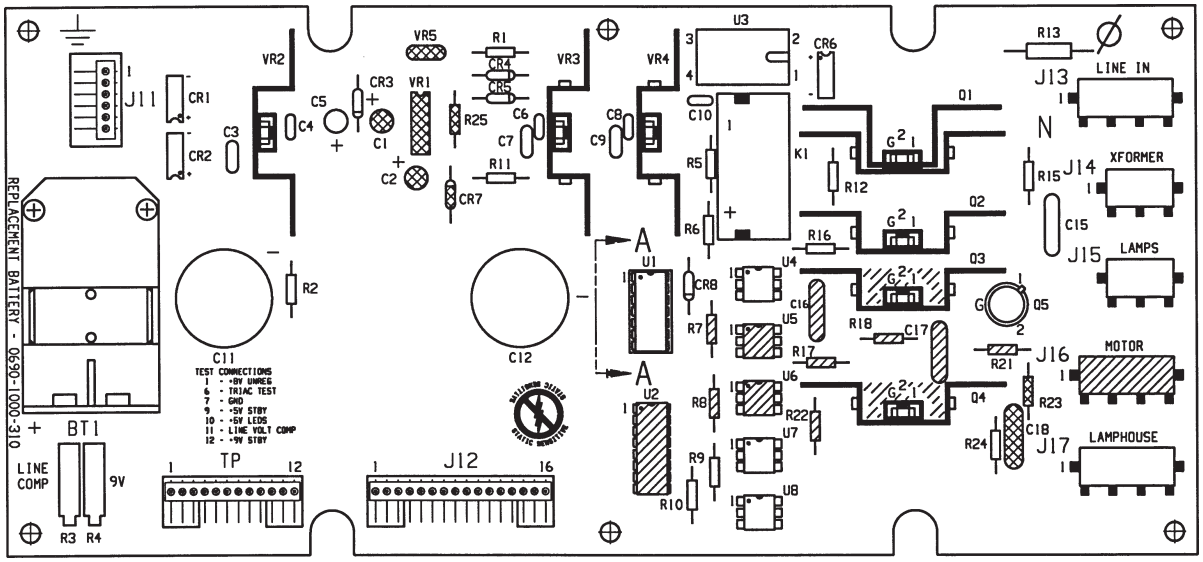


Figure 7-51
Power Supply Board Layout
Model 2001, 3000, 3300, and 3500
Units with HAK or AAN serial numbers

DESCRIPTION	QTY	SYMBOL
ESD SENSITIVE DEVICE HNDL/PKG STD		
LOT NUMBERING SPECIFICATION		
FUNCTIONAL DESCRIPTION		
SCHEMATIC		
PC BOARD, BLANK	1	
4-40 X 1/4 SCREW	2	H1
4-40 ELASTIC STOP NUT	5	H4
NO.4 LOCKWASHER	2	H2
4-40 HEX NUT	2	H3
HEADER, 3 SOCKET 350825-1	1	J17
HEADER, 3 PIN 350789-1	1	J13
HEADER, 2 SOCKET 350824-1	1	J15
HEADER, 2 PIN 350786-1	1	J14
HEADER, 16 PIN 1100-9-116-01	1	J12
HEADER, 12 PIN 1100-9-112-01	1	TP
HEADER, 6 PIN 1100-9-106-01	1	J11
SOCKET, 16 PIN MODIFIED	1	FOR U1
HEAT SINK, 6071B	1	H6
HEAT SINK, 6070B SF-1 MT	5	H5
BATTERY HOLDER	1	FOR BT1
IC 3040	1	U7
IC 3022	2	U4, U8
IC CNY65	1	U3
IC ULN2074B	1	U1
RELAY STIE-DC9V	1	K1
TRIAC SPACER	1	FOR Q5
TRIAC MAC 15A-8	2	Q1, Q2
TRIAC T2300	1	Q5
VOLTAGE REG 7805C	3	VR2,VR3,VR4
BRIDGE RECTIFIER VM08	3	CR1,CR2,CR6
DIODE VSK120	1	CR4
DIODE	3	CR3,CR5,CR8
CAPACITOR .47 MFD	1	C10
CAPACITOR 4700 MFD 35V	2	C11,C12
CAPACITOR 15 MFD 35V 20	1	C5
CAPACITOR .33 MFD	3	C3,C7,C9
CAPACITOR 0.1 MFD	3	C4,C6,C8
CAPACITOR .01 MFD 250 VRMS	1	C15
RESISTOR, VAR 10K	1	R3
RESISTOR, VAR 1K	1	R4
RESISTOR 47K 5	1	R13
RESISTOR 100K 5	1	R5
RESISTOR 510 5 1/4W	2	R6, R10
RESISTOR 470 5 1/4W	1	R11
RESISTOR 180 5 1/4W	1	R9
RESISTOR 150 5 1/4W	3	R12, R16, R24
RESISTOR 100 5 1/4W	1	R1
RESISTOR 22 5 1/4W	1	R15
RESISTOR 100K 1 1/4W	1	R2

6600-0176-800

CI.14.098

7.52 Display Board Layout

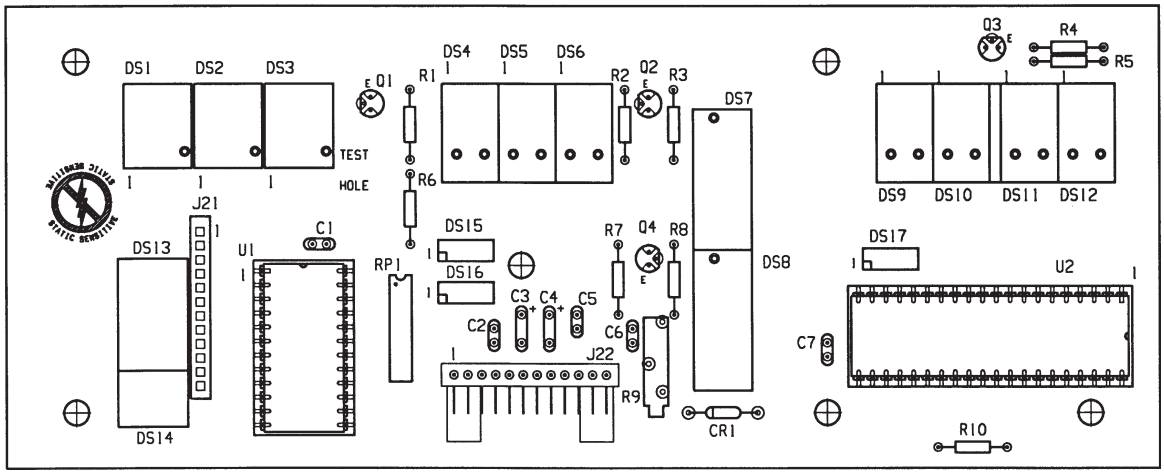
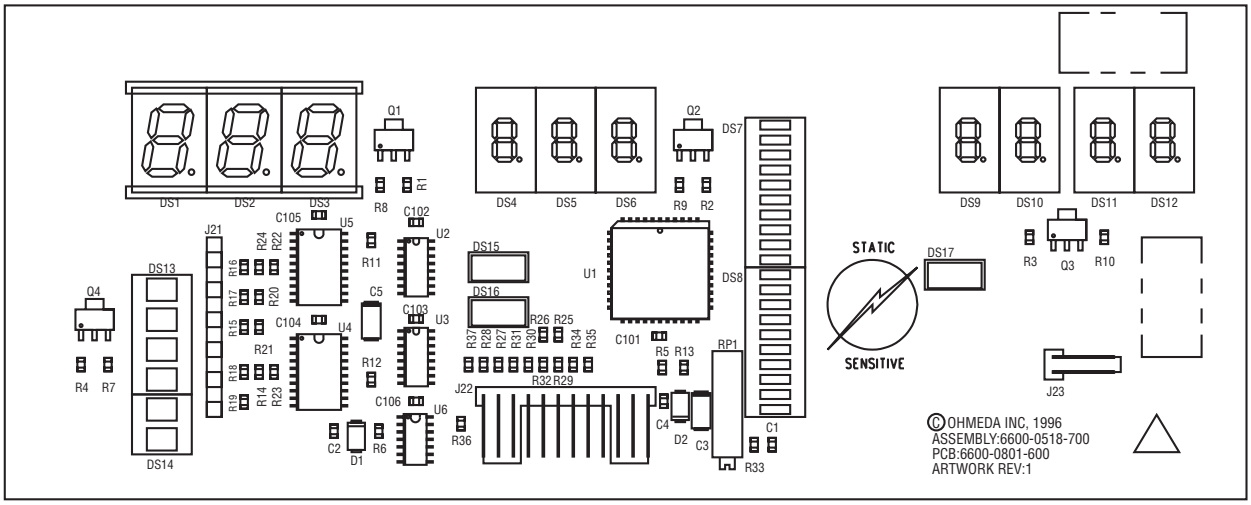


Figure 7-52
Display Board Layout

DESCRIPTION	QTY	SYMBOL
HEADER, 12 PIN, 1100-9-112-01	1	J22
SOCKET, 12 POS, SSA-112-S-T	2	FOR DS13, DS14
SOCKET, 20 POS, SSW-120-01-T-S	2	FOR DS7, DS8
SOCKET, 15 POS, SSA-115-S-T	3	FOR DS1, DS2, DS3
SOCKET, 12 POS, SSW-112-01-T-S	1	FOR J21
SOCKET, 4 POS, SSW-104-01-T-S	3	FOR DS15, DS16, DS17
SOCKET, 14 PIN, 14-8350-10WR	7	FOR DS4, DS5, DS6,
		DS9, DS10, DS11, DS12
SOCKET, 40 PIN, 840-AG11D	1	FOR U2
SOCKET, 24 PIN, 824-AG11D	1	FOR U1
LED, BAR, 8 ELEM, SEP, RED	1	DS13
LED, BAR, 4 ELEM, SEP, RED	1	DS14
LED, BAR, 2 ELEM, SOLID, YELLOW	3	DS15, DS16, DS17
LED, BAR, 10 ELEM, SEP, YELLOW	2	DS7, DS8
LED, 7 SEGMENT, .30", RED	7	DS4, DS5, DS6, DS9
		DS10, DS11, DS12
LED, 7 SEGMENT, .56", RED	3	DS1, DS2, DS3
IC MM5451 OR MM5450	1	U2
IC 8243	1	U1
TRANSISTOR MPSA63	4	Q1, Q2, Q3, Q4
DIODE	1	CR1
CAPACITOR 15 MFD	2	C3, C4
CAPACITOR 0.1 MFD 50V 20%	5	C1, C2, C5, C6, C7
RESISTOR PC 10K	1	RP1
RESISTOR 221 1% 1/4W	1	R10
RESISTOR, VARIABLE, 5K	1	R9
RESISTOR 180 5% 1/4W	4	R2, R5, R6, R7
RESISTOR 4.7K 5%	4	R1, R3, R4, R8

CI.14.075

7-53 SMT Display Board Layout



CI.14.186

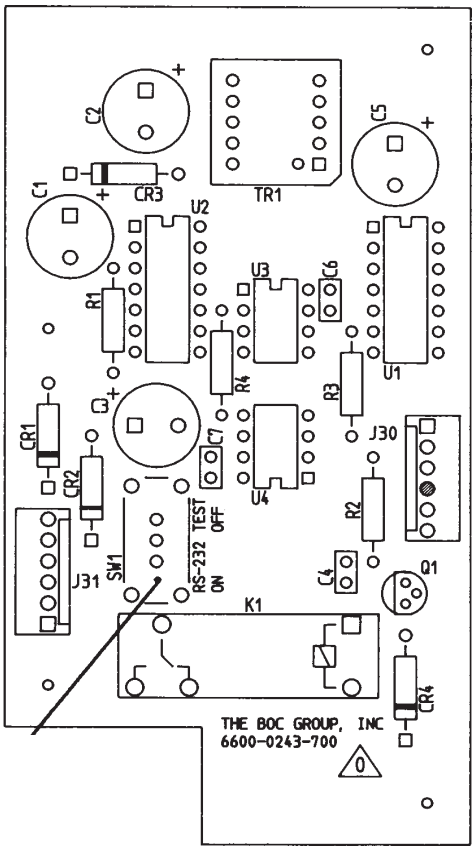
Figure 7-53
SMT Display Board Layout

6600-0602-625	CAPACITOR, 0.1UF, CERAMIC 0805, 20%	8	C1,C4,C101-C106	18
6600-0601-625	CAPACITOR, 1000PF, CERAMIC 0805, 10%	1	C2	18
6600-0603-602	CAPACITOR, 15UF, TANTALUM	2	C3,C5	18
6600-0615-601	DIODE, SMA	2	D1,D2	18
0690-2300-326	LED, 8 SEGMENT, HDSP-5531	3	DS1-DS3	7,8,18
0690-2300-325	LED, 8 SEGMENT, HDSP-5082	7	DS4-DS6, DS9-DS12	7.9.18
0683-9100-300	LED, 10 SEGMENT, HDSP-4840	2	DS7-DS8	7,10,18
0683-9020-303	LED, 4 SEGMENT, HLMP-2620	1	DS13	5.7.18
0683-9020-302	LED, 2 SEGMENT, HLMP-2600	1	DS14	5.7.18
0683-9020-304	LED, 1 SEGMENT, HLMP-2400	3	DS15-DS17	7,11,18
0690-2400-321	SOCKET, 15PIN, STRAIGHT	2	XDS1-XDS3	8,18
0690-2400-312	SOCKET, 14PIN, DIP	7	XDS4-XDS6, XDS9-XDS12	9,18
0690-2400-317	SOCKET, 20PIN, DIP	2	XDS7-XDS8	10,18
0690-2400-320	SOCKET, 12PIN, STRAIGHT	2	XDS13-XDS14	5,18
0690-2400-316	SOCKET, 4PIN, STRAIGHT	3	XDS15-XDS17	11,18
0690-2400-318	CONNECTOR, 12PIN, STRAIGHT	1	J21	18
6600-0340-612	CONNECTOR, 12PIN, RT. ANGLE	1	J22	6,18
6600-0340-602	CONNECTOR, 2PIN, RT. ANGLE	1	J23	18
6600-0617-600	TRANSISTOR, SOT-223, PZTA64	4	Q1-Q4	18
6600-0609-618	RESISTOR, 180, 5%, 0805	6	R1-R6	18
6600-0609-647	RESISTOR, 4.7K, 5%, 0805	6	R7-R12	18
6600-0610-620	RESISTOR, 221, 1%, 0805	1	R13	18
6600-0609-655	RESISTOR, 10K, 5%, 0805	19	R14-R28, R34-R37	18
6600-0609-607	RESISTOR, 33, 5%, 0805	4	R29 - R32	18
6600-0352-609	POTENTIOMETER, 5K, 3006P	1	RP1	18
6600-0614-600	IC, M5451, PLCC 44	1	U1	18
6600-0663-600	IC,74HC175, S0-16	1	U2	18
6600-0664-600	IC, 74HC138, SO-16	1	U3	18
6600-0665-600	IC, 74HC244, SOL-20	2	U4,U5	18
6600-0666-600	IC, 74HC132, SO-14	1	U6	18
6600-0801-600	PC BOARD BLANK	1		
6600-1045-100	LOT/SERIAL NUMBERING SPEC	REF		12
6600-1027-100	ESD SENSITIVE DEVICE HNDL/PKG STD	REF		1,20
6600-2201-100	TEST SPECIFICATION	REF		13
6600-2200-100	FUNCTIONAL DESCRIPTION	REF		
6600-2203-100	SCHEMATIC	REF		
PART NUMBER	DESCRIPTION	QTY	REFERENCE DESIGNATOR	NOTES

Cl.14.187

7.54 ThermaLink Board Layout

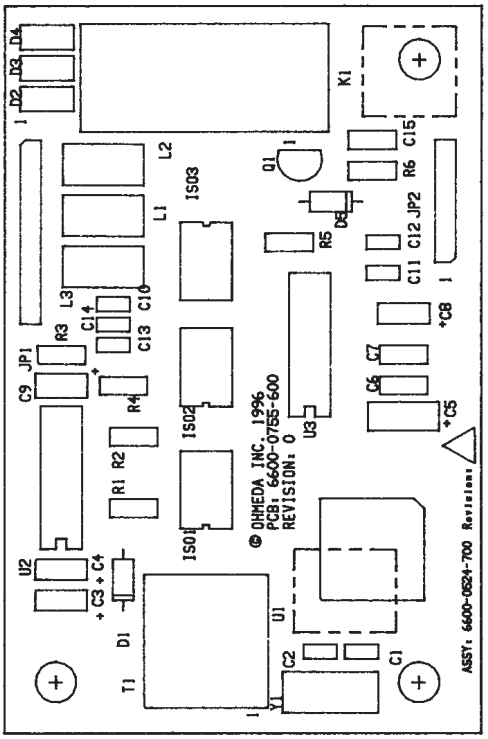
Boards with test switch



CI.08.005

RS-232
Self test switch

Boards without test switch



CI.14.167

Figure 7-54
ThermaLink Board Layout
Units with HCA serial numbers

Components - ThermaLink Board with test switch

RESISTOR 220 5%	1	R1
RESISTOR 3 K 5%	1	R2
RESISTOR 3.9 K 5%	2	R3, R4
CAPACITOR 1 UF	3	C1, C2, C5
CAPACITOR 4.7 UF	1	C3
CAPACITOR 0.1 UF	1	C4
TRANSISITOR MPSA14	1	Q1
BI-DIR ZENER SA24C	2	CR1, CR2
DIODE 1N4001	2	CR3, CR4
RELAY AM ZETTLER AZ696-1C-5DE	1	K1
TRANSFORMER SCHOTT 67122750	1	TR1
IC MAX250CPD	1	U1
IC MAX251CPD	1	U2
IC 6N136	2	U3, U4
HEADER 6 PIN	2	J30, J31
SLIDE SWITCH MSS-1200	1	SW1
DESCRIPTION	QTY	SYMBOL

Components - ThermaLink Board without test switch

CRYSTAL 11.059 MHZ	1	Y1
TRANSFORMER	1	T1
TRANSISTOR MPSA14	1	Q1
INDUCTOR FERRITE BEAD	3	L1.L2.L3
RELAY SPDT 10 A	1	K1
HEADER 6 PIN	1	JP2
HEADER 9 PIN	1	JP1
IC OPTO ISOLATOR 6N136	3	IS01.IS02.IS03
SOCKET PLCC 44 PIN	1	U1 SOCKET
IC RS232 DRIVER MAX250	1	U3
IC RS232 DRIVER MAX251	1	U2
MICROCONTROLLER PROGRAMMED 87C52	1	U1
TRANSIENT SUPPRESSOR SMBJ24CA	3	D2.D3.D4
DIODE 1N4001	2	D1.D5
RESISTOR 3.9 KOHMS 5 % 1/8 W	4	R1.R2.R5.R6
RESISTOR 220 OHMS 5 % 1/8 W	2	R3.R4
CAPACITOR 4.7 UFD 10 V 20%	1	C9
CAPACITOR 10 UFD 10 V 20%	1	C5
CAPACITOR 1 UFD 20 V 20%	3	C3.C4.C8
CAPACITOR 0.1 UFD 50 V 20%	3	C6.C7.C15
CAPACITOR 33 PFD 50 V 10%	7	C1.C2.C10.C11.C12. C13.C14
PC BOARD BLANK	1	
ESD SENSITIV DEVICE HANDLING STD	REF	
LOT/SERIAL NUMBER SPECIFICATION	REF	
TEST SPECIFICATION	REF	
FUNCTIONAL DESCRIPTION	REF	
SCHEMATIC	REF	
DESCRIPTION	QTY	REF DESIGNATION

CI.14.166

7.55 EMI Noise Suppression

Electrostatic discharge (ESD) shielding and grounding improvements have been made to all new IWS models. Improvements have also been added to reduce IWS susceptibility to power line conducted and radiated electromagnetic interference (EMI).

Older units will require ESD shielding when the controller board is replaced. Each controller service kit includes EMI shielding to minimize susceptibility of the replacement controller board to Electrostatic discharge, power line conducted and radiated electromagnetic interference.

WARNING ⚠ **Do not install the control board without ESD shielding in place. Failure to do so may result in hazardous ESD induced failures.**

To confirm that your IWS unit has shielding already in place, remove the controller cover. The large silver control board shield should be the first thing you see. Refer to Figure 7-1.

Order kits:

6600-0360-800 EMI Noise Suppression Kit for English IWS Models
6660-0360-801 EMI Noise Suppression Kit for French IWS Models
6600-0360-802 EMI Noise Suppression Kit for Spanish IWS Models
6600-0360-803 EMI Noise Suppression Kit for German IWS Models
6600-0360-804 EMI Noise Suppression Kit for Spanish IWS 2001 Models
6600-0360-805 EMI Noise Suppression Kit for French IWS 2001 Models
6600-0360-806 EMI Noise Suppression Kit for English IWS 2001 Models

Kits include:

Control board 6600-0101-850
Line filter 6600-0170-600
Switch panel (English) 0208-5129-300
Ribbon cable 6600-0211-700
Display board EMI shield 6600-0508-500
Control board EMI shield 6600-0509-500
Shielded cable assembly 6600-0261-600

Miscellaneous hardware including stand offs, spring clips, screws and washers.

7.56 Label Sets

A

Refresher Instructions

DANGER: Possible explosion hazard.
Do not use in the presence of flammable anesthetics.

Important: Do not place items on top of Warmer Module. For detailed instructions, warnings and precautions refer to Operation and Maintenance Manual.

Start Up

1. Place power switch in the **On** position. An initial self check is performed. All the indicators will light and the audible alarm will sound for four seconds. If an alarm persists, remove the unit for servicing.
2. The warmer is programmed to begin operation in the manual mode; an operator prompt tone will sound and the % power bar indicator will flash until a % power setting is selected.

Manual Mode

1. Activate the Manual Mode. Select the % Power desired with the or switch.
2. Preheat - Power levels of 25% or less can be used for preheating the warmer. The **Check Patient** alarm is inactive within this power range.
3. The probe may be used for temperature monitoring

Servo Mode

1. Attach probe to patient and connect probe to control console.
2. Activate the Servo Mode. Select the Control Temperature desired with the or switch.

Alarms

1. **Probe Failure** - Check the patient probe and replace if required.
2. **Patient Temp** - Patient Temperature is more than ±1°C from the **Control Temperature**.
3. **System Failure** - Unit malfunction, remove for servicing.
4. **Heater Off** - Heater assembly in the x-ray position.
5. **Check Patient** - Activates after 12 minutes in the manual mode if power level is greater than 25 % or after 12 minutes of continuous full power in the servo mode.
6. (Alarm silence symbol) - Silences Probe Failure, Patient Temp., Heater Off, and Check Patient Alarms.

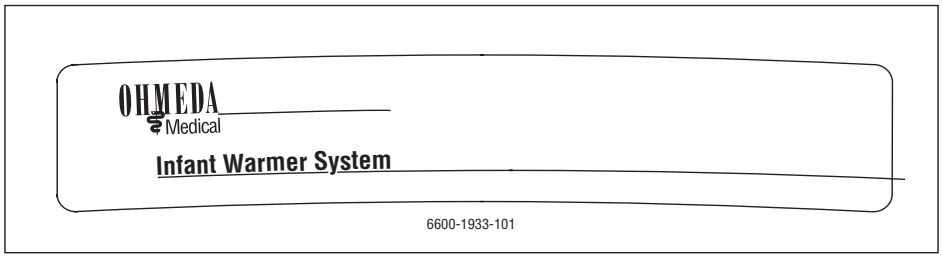
B

Celcius / Fahrenheit Conversion Table

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
25.0	77.0	28.2	82.8	31.4	88.5	34.6	94.3	37.8	100.0
25.1	77.2	28.3	82.9	31.5	88.7	34.7	94.5	37.9	100.2
25.2	77.4	28.4	83.1	31.6	88.9	34.8	94.6	38.0	100.4
25.3	77.5	28.5	83.3	31.7	89.1	34.9	94.8	38.1	100.6
25.4	77.7	28.6	83.5	31.8	89.2	35.0	95.0	38.2	100.8
25.5	77.9	28.7	83.7	31.9	89.4	35.1	95.2	38.3	100.9
25.6	78.1	28.8	83.8	32.0	89.6	35.2	95.4	38.4	101.1
25.7	78.3	28.9	84.0	32.1	89.8	35.3	95.5	38.5	101.3
25.8	78.4	29.0	84.2	32.2	90.0	35.4	95.7	38.6	101.5
25.9	78.6	29.1	84.4	32.3	90.1	35.5	95.9	38.7	101.7
26.0	78.8	29.2	84.6	32.4	90.3	35.6	96.1	38.8	101.8
26.1	79.0	29.3	84.7	32.5	90.5	35.7	96.3	38.9	102.0
26.2	79.2	29.4	84.9	32.6	90.7	35.8	96.4	39.0	102.2
26.3	79.3	29.5	85.1	32.7	90.9	35.9	96.6	39.1	102.4
26.4	79.5	29.6	85.3	32.8	91.0	36.0	96.8	39.2	102.6
26.5	79.7	29.7	85.5	32.9	91.2	36.1	97.0	39.3	102.7
26.6	79.9	29.8	85.6	33.0	91.4	36.2	97.2	39.4	102.9
26.7	80.1	29.9	85.8	33.1	91.6	36.3	97.3	39.5	103.1
26.8	80.2	30.0	86.0	33.2	91.8	36.4	97.5	39.6	103.3
26.9	80.4	30.1	86.2	33.3	91.9	36.5	97.7	39.7	103.5
27.0	80.6	30.2	86.4	33.4	92.1	36.6	97.9	39.8	103.6
27.1	80.8	30.3	86.5	33.5	92.3	36.7	98.1	39.9	103.8
27.2	81.0	30.4	86.7	33.6	92.5	36.8	98.5	40.0	104.0
27.3	81.1	30.5	86.9	33.7	92.7	36.9	98.4	40.1	104.2
27.4	81.3	30.6	87.1	33.8	92.8	37.0	98.6	40.2	104.4
27.5	81.5	30.7	87.3	33.9	93.0	37.1	98.8	40.3	104.5
27.6	81.7	30.8	87.4	34.0	93.2	37.2	99.0	40.4	104.7
27.7	81.9	30.9	87.6	34.1	93.4	37.3	99.1	40.5	104.9
27.8	82.0	31.0	87.8	34.2	93.6	37.4	99.3	40.6	105.1
27.9	82.2	31.1	88.0	34.3	93.7	37.5	99.5	40.7	105.3
28.0	82.4	31.2	88.2	34.4	93.9	37.6	99.7	40.8	105.4
28.1	82.6	31.3	88.3	34.5	94.1	37.7	99.9	40.9	105.6
								41.0	105.8

LABEL SET, INSTRUCTIONS, IWS, EN
6600-1925-101

English	6600-1925-101
French	6600-1925-102
Spanish	6600-1925-103
German	6600-1925-104
Italian	6600-1925-105
Swedish	6600-1925-106
Japanese	6600-1925-107



6600-1933-101

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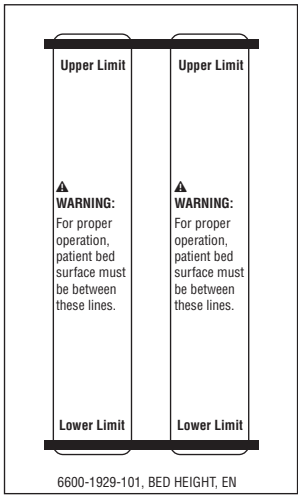
German	6600-1933-104
Italian	6600-1933-105
Swedish	6600-1933-106
Japanese	6600-1933-107



6600-1929-101, BED HEIGHT, EN

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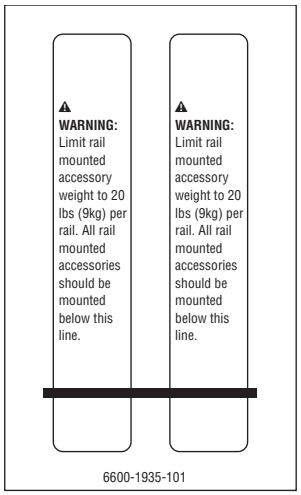
French	6600-1929-102
Spanish	6600-1929-103
German	6600-1929-104
Italian	6600-1929-105
Swedish	6600-1929-106
Japanese	6600-1929-107



6600-1935-101

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French	6600-1935-102
Spanish	6600-1935-103
German	6600-1935-104
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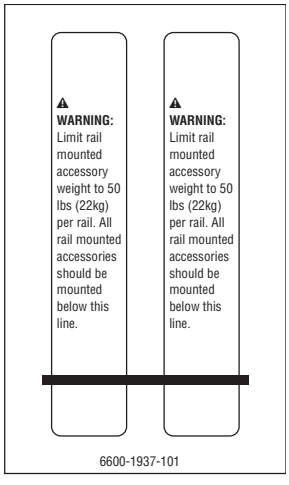
Swedish	6600-1935-106
Japanese	6600-1935-107



6600-1937-101

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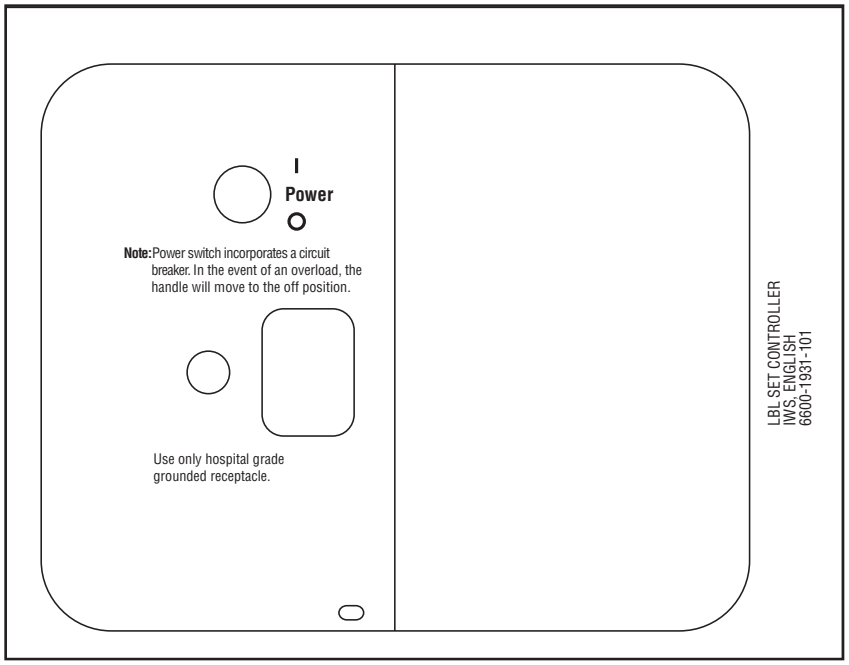
French	6600-1937-102
Spanish	6600-1937-103
German	6600-1937-104
Italian	6600-1937-105
Swedish	6600-1937-106
Japanese	6600-1937-107



English	6600-1931-101
French	6600-1931-102
Spanish	6600-1931-103
German	6600-1931-104
Italian	6600-1931-105
Swedish	6600-1931-106
Japanese	6600-1931-107

CI.14.145

Shelf Load Limit

20 lbs. max (9kg)

6600-1939-101

English	6600-1939-101
French	6600-1939-102
Spanish	6600-1939-103
German	6600-1939-104
Italian	6600-1939-105
Swedish	6600-1939-106
Japanese	6600-1939-107

Shelf Load Limit

50 lbs. (22kg) max at 56" from floor (1.4m)

6600-1941-101

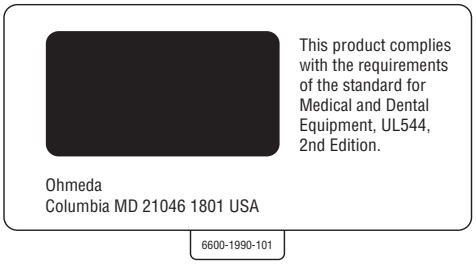
English	6600-1941-101
French	6600-1941-102
Spanish	6600-1941-103
German	6600-1941-104
Italian	6600-1941-105
Swedish	6600-1941-106
Japanese	6600-1941-107

English	6600-1975-101
French	6600-1975-102
Spanish	6600-1975-103
German	6600-1975-104
Italian	6600-1975-105
Swedish	6600-1975-106
Japanese	6600-1975-107

⚠ **CAUTION:** Maximum Drawer Load: 5 lbs. (2.25 Kg)

6600-1996-101

English	6600-1996-101
French	6600-1996-102
Spanish	6600-1996-103
German	6600-1996-104
Italian	6600-1996-105
Swedish	6600-1996-106
Japanese	6600-1996-107



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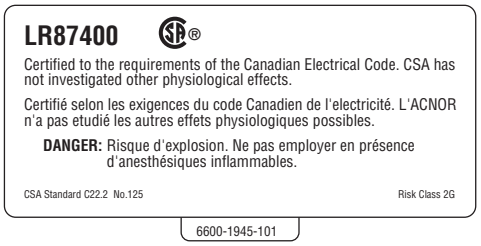
6600-1990-101 Only

Contact Technical Support to order

⚠ **CAUTION:** Maximum Drawer Load: 8 lbs. (3.64 Kg)

6600-1998-101

English	6600-1998-101
French	6600-1998-102
Spanish	6600-1998-103
German	6600-1998-104
Italian	6600-1998-105
Swedish	6600-1998-106
Japanese	6600-1998-107



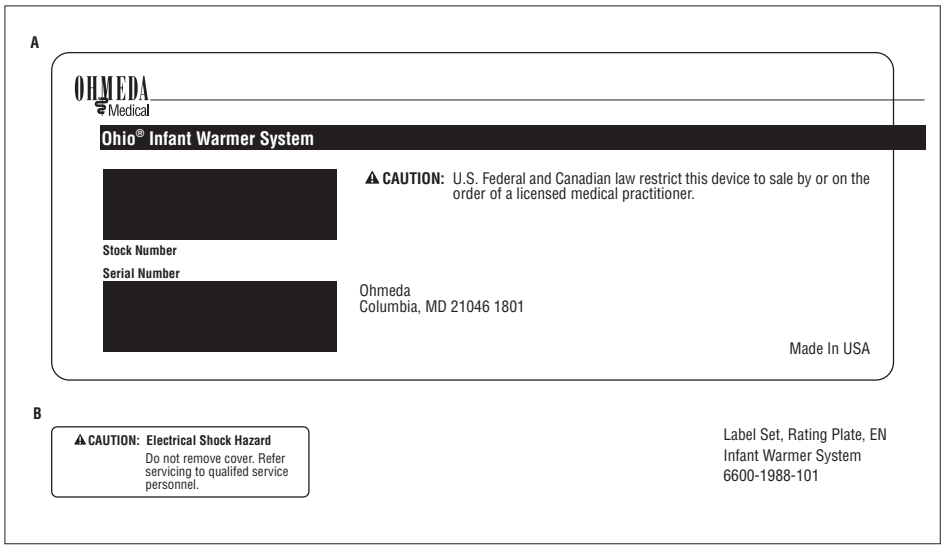
CI.14.152

6600-1945-101 Only
Contact Technical Support to order

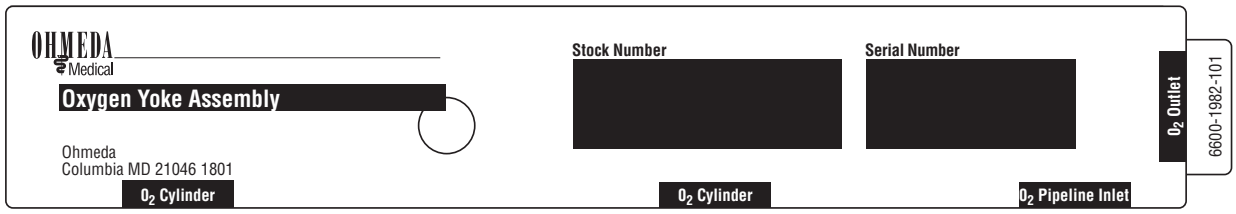
⚠ **WARNING:** Do not leave patient unattended when side panels are lowered.

6600-1959-101

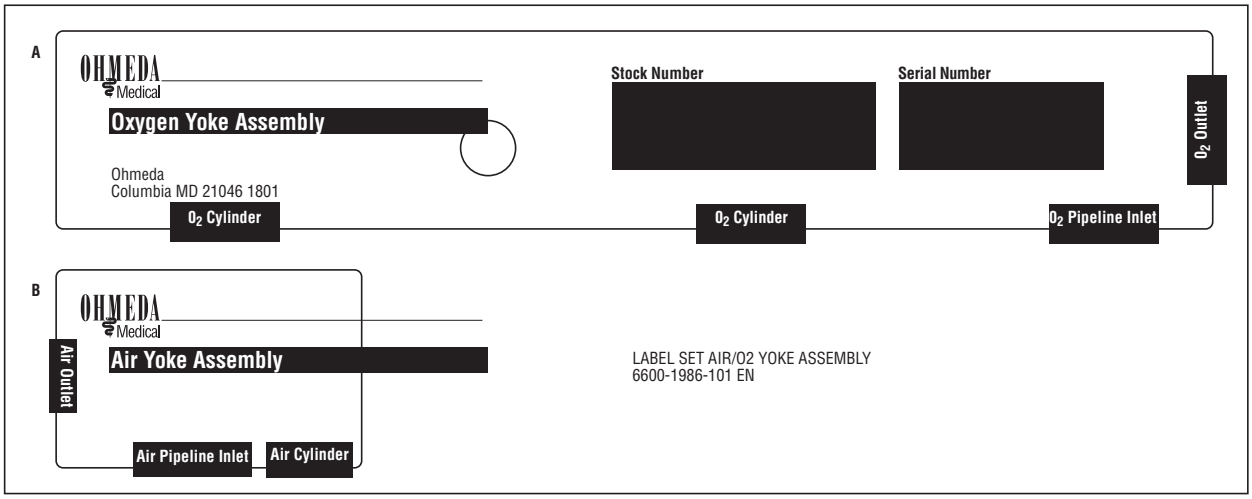
English	6600-1959-101
French	6600-1959-102
Spanish	6600-1959-103
German	6600-1959-104
Italian	6600-1959-105
Swedish	6600-1959-106
Japanese	6600-1959-107



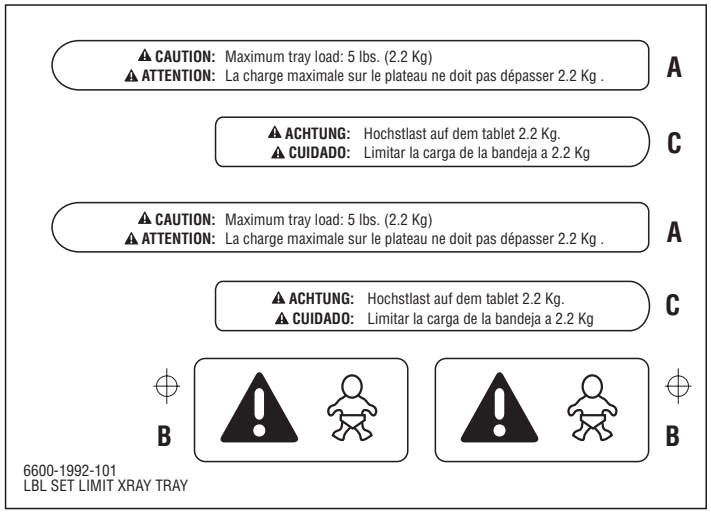
English	6600-1988-101
French	6600-1988-102
Spanish	6600-1988-103
German	6600-1988-104
Italian	6600-1988-105
Swedish	6600-1988-106
Japanese	6600-1988-107



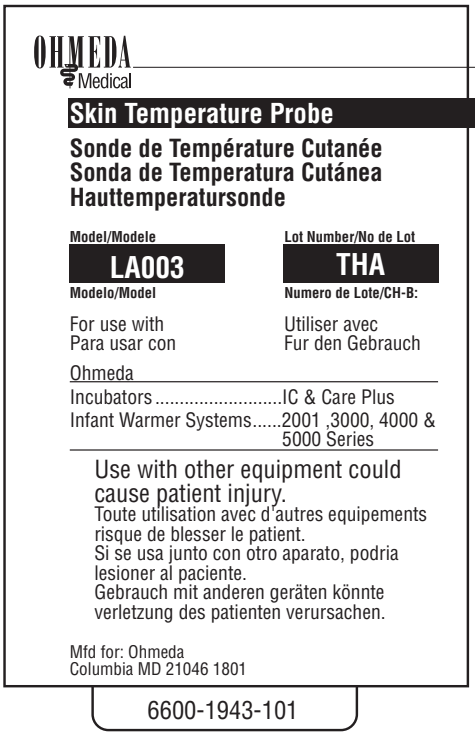
Contact Technical Support to order



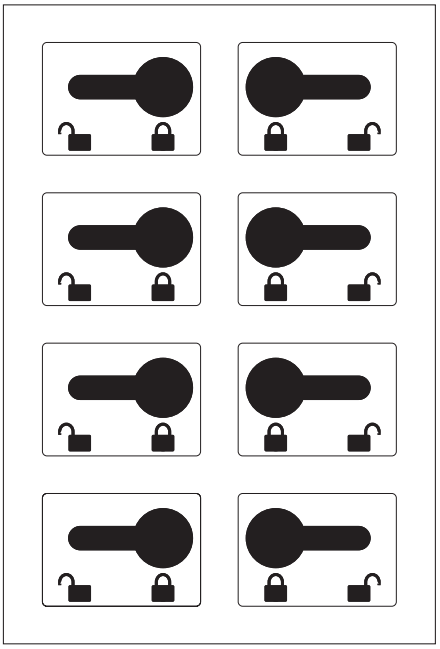
Contact Technical Support to order



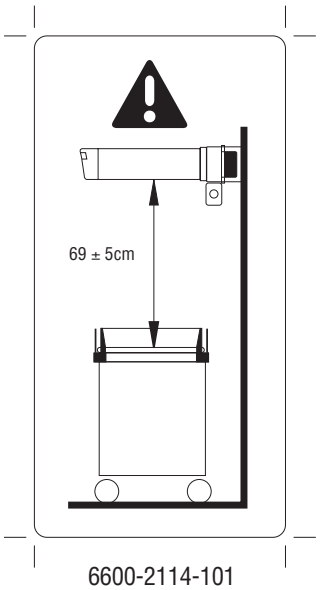
6600-1992-101 Only



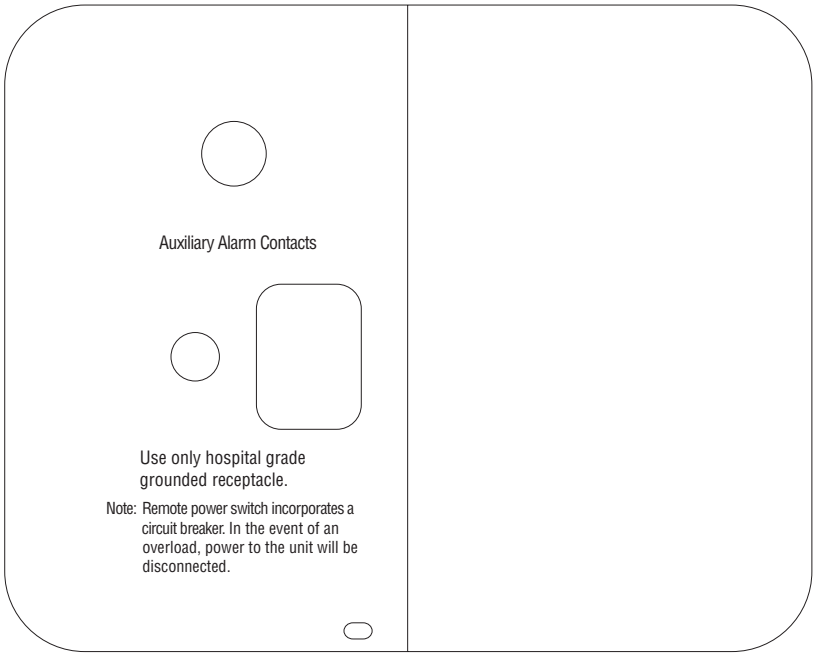
6600-1943-101 Only



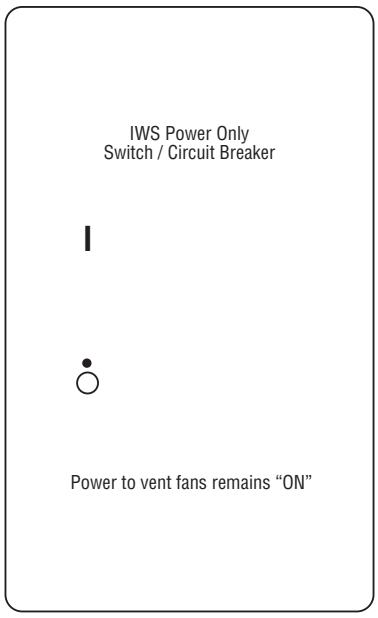
6600-1994-101 Only



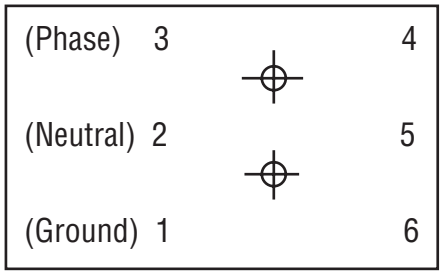
6600-2114-101

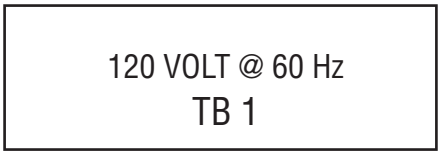


6600-2271-101



6600-2279-101



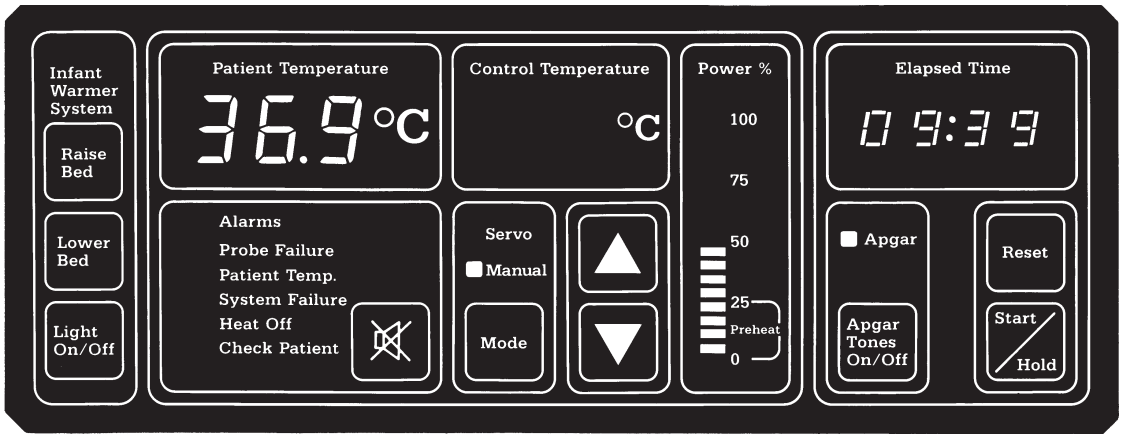


6600-2283-101

6600-2284-100

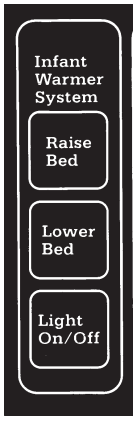
6600-2288-101

Switch Panel Label - Units with HAK, HAJ, AAN and HCA Serial Numbers



English	0205-4945-300
Spanish	6600-0462-100
French	6600-0100-100
German	6600-0472-100
Italian	6600-1549-100
Swedish	6600-1551-100

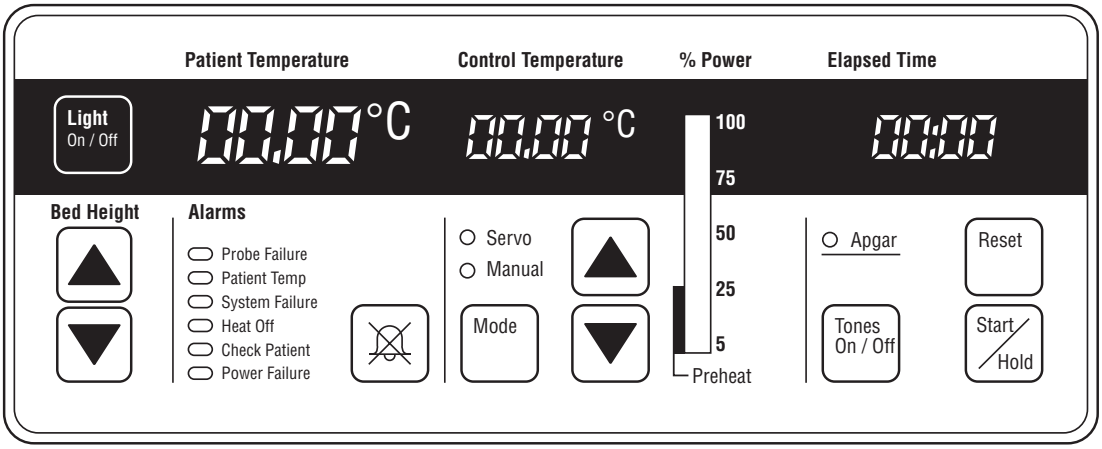
Model 2001, English (Includes model no. insert)	6600-0238-100
Model 2001, Spanish (Includes model no. insert)	6600-0266-100
Model 2001, French (Includes model no. insert)	6600-0267-100



Model Number	English	Spanish	French	German	Italian	Swedish
3000	6600-1461-100	6600-1461-101	6600-1461-102	6600-1461-103	6600-1461-104	6600-1461-105
3050	6600-1461-106	6600-1461-107	6600-1461-108	6600-1461-109	6600-1461-110	6600-1461-111
3100	6600-1461-112	6600-1461-113	6600-1461-114	6600-1461-115	6600-1461-116	6600-1461-117
3150	6600-1461-118	6600-1461-119	6600-1461-120	6600-1461-121	6600-1461-122	6600-1461-123
3300	6600-1461-124	6600-1461-125	6600-1461-126	6600-1461-127	6600-1461-128	6600-1461-129
3500	6600-1461-130	–	–	–	–	–
4000	6600-1461-136	6600-1461-137	6600-1461-138	6600-1461-139	6600-1461-140	6600-1461-141
4300	6600-1461-142	6600-1461-143	6600-1461-144	6600-1461-145	6600-1461-146	6600-1461-147
4400	6600-1461-148	6600-1461-149	6600-1461-150	6600-1461-151	6600-1461-152	6600-1461-153
5000	6600-1461-154	6600-1461-155	6600-1461-156	6600-1461-157	6600-1461-158	6600-1461-159

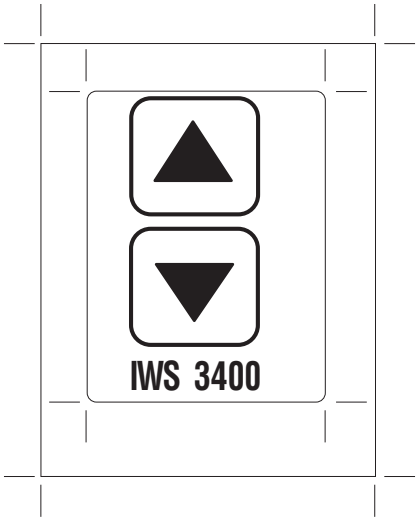
Model Number Insert
Units with AAN, HAK and HCA serial numbers

Switch Panel Label - Units with HCC Serial Number



English	6600-1920-101
French	6600-1920-102
Spanish	6600-1920-103
German	6600-1920-104
Italian	6600-1920-105
Swedish	6600-1920-106
Japanese	6600-1920-107

Model 2001, English	6600-1923-101
Model 2001, French	6600-1923-102
Model 2001, Spanish	6600-1923-103

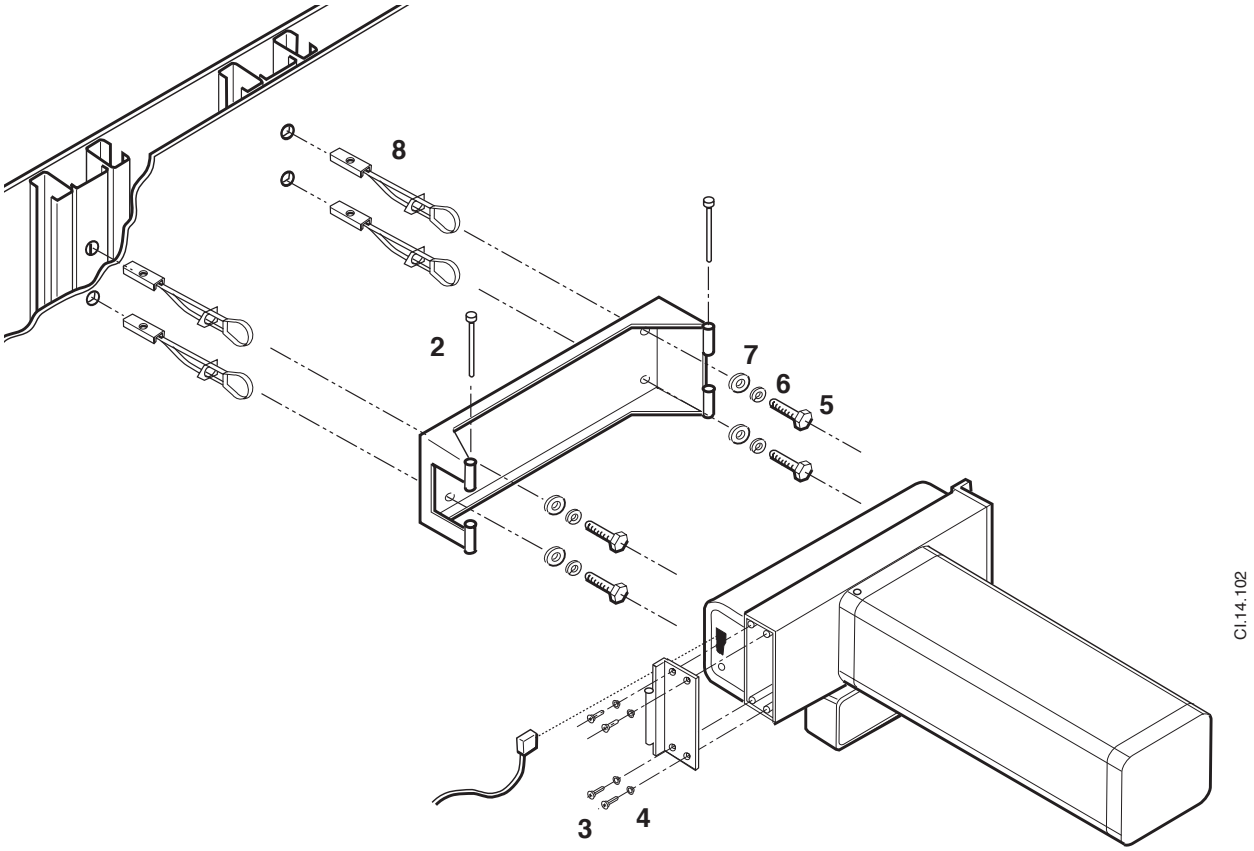


Model number insert
Units with HCC serial number

6600-2048-101

IWS 2001	6600-2046-101
IWS 3000	6600-2046-102
IWS 3050	6600-2046-103
IWS 3100	6600-2046-104
IWS 3150	6600-2046-105
IWS 3300	6600-2046-106
IWS 3400	6600-2048-101
IWS 3500	6600-2046-107
IWS 4000	6600-2046-111
IWS 4300	6600-2046-115
IWS 4400	6600-2048-102

7.57 Wall Mounted Units



	Description	Stock Number
1.	Hinge, Model 3050 (includes endplate and pin)	6600-0562-501
	Model 3100, 3150	6600-0608-501
2.	Hinge pin	6600-0596-400
3.	Screw, self tapping flat head, 1/4 x 1	0142-4247-116
4.	Conical washer*	6600-0484-400
5.	Screw, self tapping hex head, .375-16 x 2.5	6600-0414-400
6.	Split ring lock washer, .375	6600-0440-400
7.	Flatwasher, .81 OD .406 ID	6600-0173-400
8.	Toggler® Anchor bolt	6600-0413-400

** Model 3050 only.*

Figure 7-55
Wall mounted units

7.58 Armoire Cabinet Units

1. Screw, #5-40 x 1/2" 6600-0790-400
2. Male detent 6600-1045-502
3. Trolley 6600 0572-700
4. Trolley adapter plate 6600-1040-500
5. Lock washer, split ring 5/16î (black anodized trolley) 6600-0608-400
   Lock washer, split ring (clear anodized trolley) 6600-0713-406
6. Screw, 5/16-18 x 7/8" (black anodized trolley)@ 6600-0787-400
   Screw, M8-1.25 x 20 (clear anodized trolley)@ 6600-0707-428
7. Lock washer, spit ring 1/4" 6600-0473-400
8. Screw, 1/4-20 x 1 1/4"@* 6600-0784-400
9. Cross member 6600-0341-709

*Torque to 90 + 10 lb. in.
@ apply loctite 242

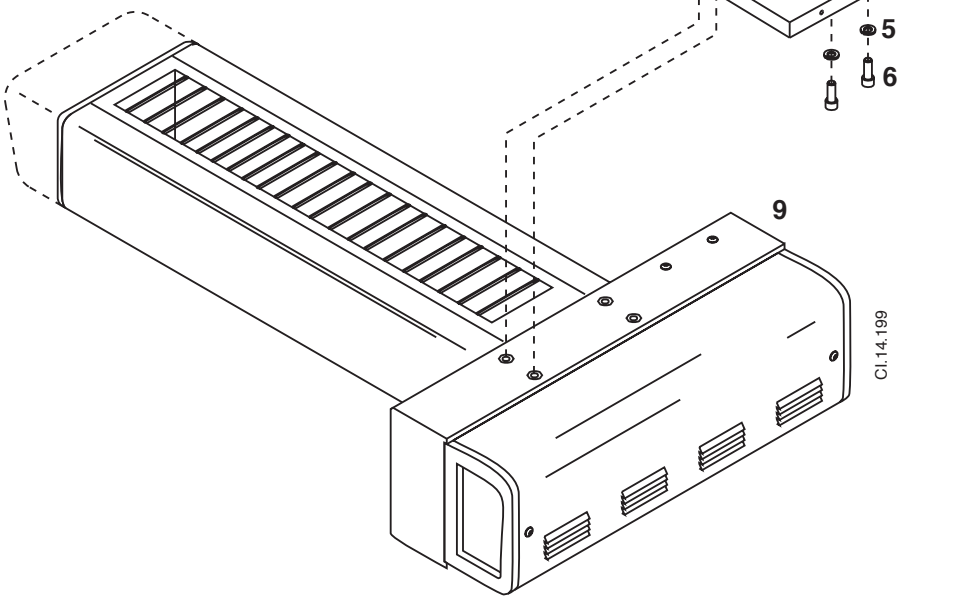
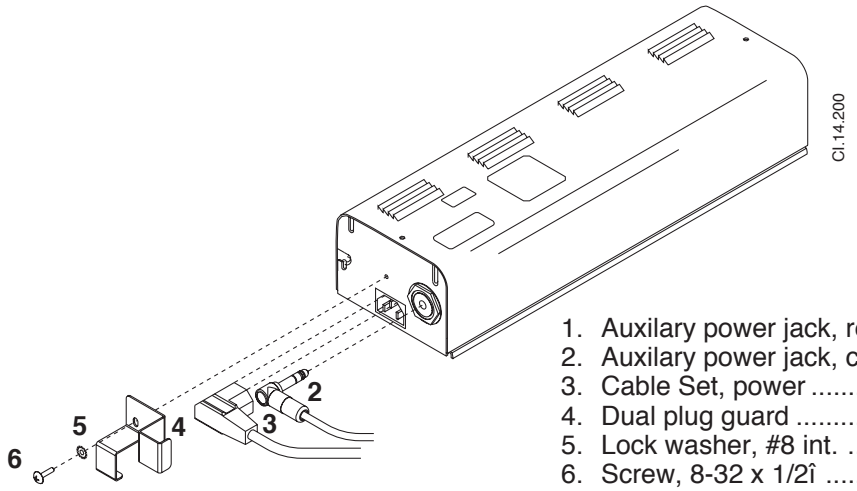


Figure 7-56
Model 3051 trolley



1. Auxilary power jack, receptacle 6600-0817-600
2. Auxilary power jack, cable 6600-0821-600
3. Cable Set, power 6600-0825-600
4. Dual plug guard 6600-1512-500
5. Lock washer, #8 int. 6600-0262-400
6. Screw, 8-32 x 1/2î 0140-6627-108

Figure 7-57
Model 3051 Power connections

1.	Lock nut, M4	6600-0714-402
2	Fan guard	6600-1060-500
3.	Fan Wire Harness	6600-0574-700
4.	Fuse, Fast-Act 1A 250.25x1.25"	6600-0827-600
5.	Spacer	6600-1039-500
6.	Screw, M6-1x110 Skt Hd*	6600-0786-400
7.	Bumper	6600-1044-500
8.	Washer, flat 3/8"	6600-0797-400
9.	Screw, 8-32 x 5/8"	6600-0801-400
10.	Shroud	6600-1043-500
11.	Retainer	6600-0793-400
12.	Captive screw, Phillips	6600-0796-400
13.	Detent plate	6600-1046-500
14.	Screw, 8-32 x 3/8"	6600-0788-400
15.	Detent, female	6600-1045-501
16.	Lock washer, counter sunk	6600-0712-447
17.	Screw, M4x8	6600-0715-404
18.	Mounting track@	6600-0573-700
19.	Rubber Grommet	6600-0804-400
20.	Fan guard with (1) filter (includes items 11& 21)	6600-1086-500
21.	Fan filter, 5 pcs.	6600-0893-200
22.	Screw, M4 x 20	6600-0708-411
23.	Fan 50CFM	6600-0823-600
24.	Fan isolator	6600-1526-500
25.	Shoulder bolt, 4-40	6600-0838-400
26.	Mounting plate	6600-1041-500
27.	Screw, 8-32 x 3/8"	0140-6127-106
28.	#8 Lock washer	6600-0262-400
29.	Screw, 1/4 - 20 x 11/2"	6600-0785-400
30.	Washer	6600-0791-400

*Torque to 100-120 lb. in.

@ apply Lubriplate to track rails

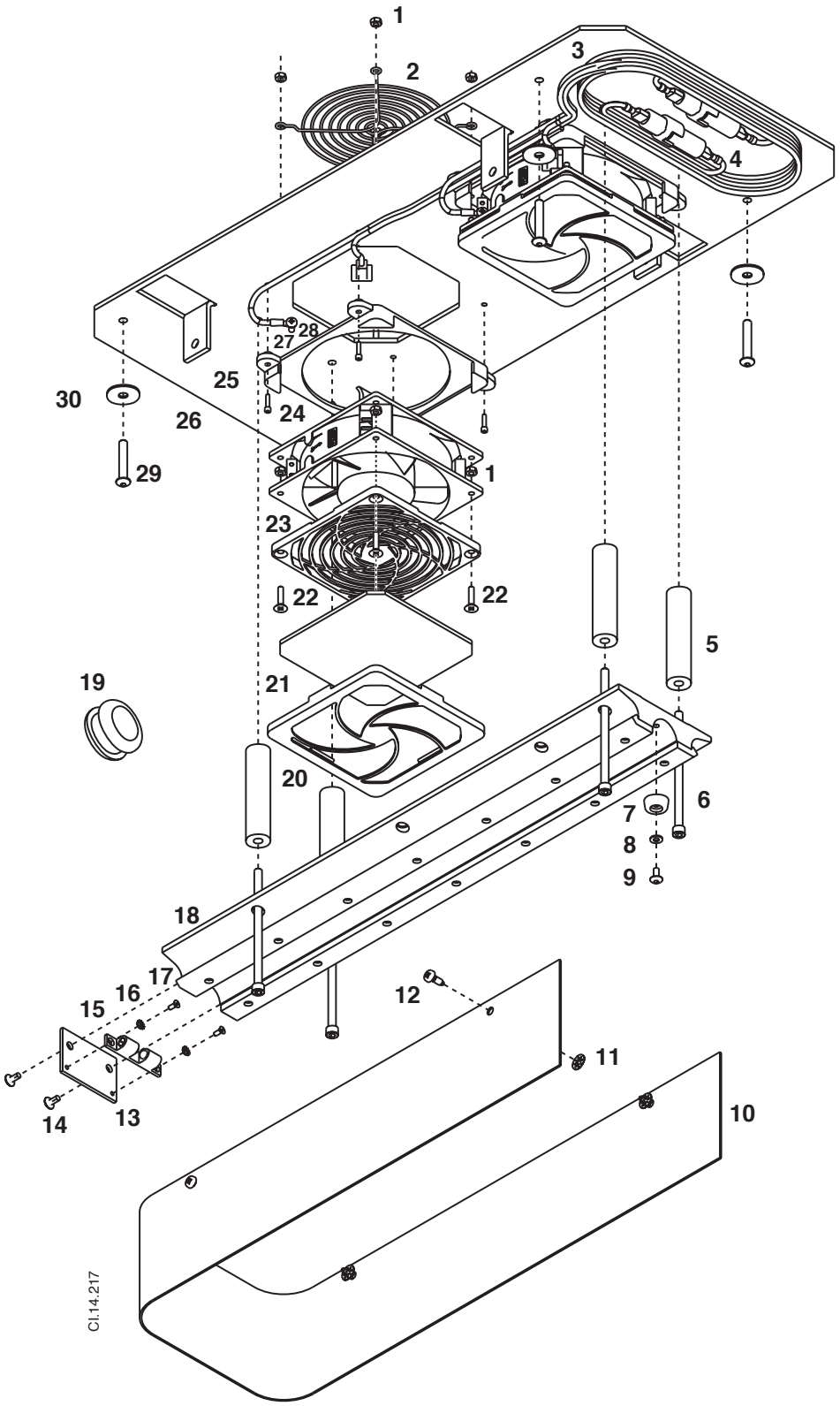
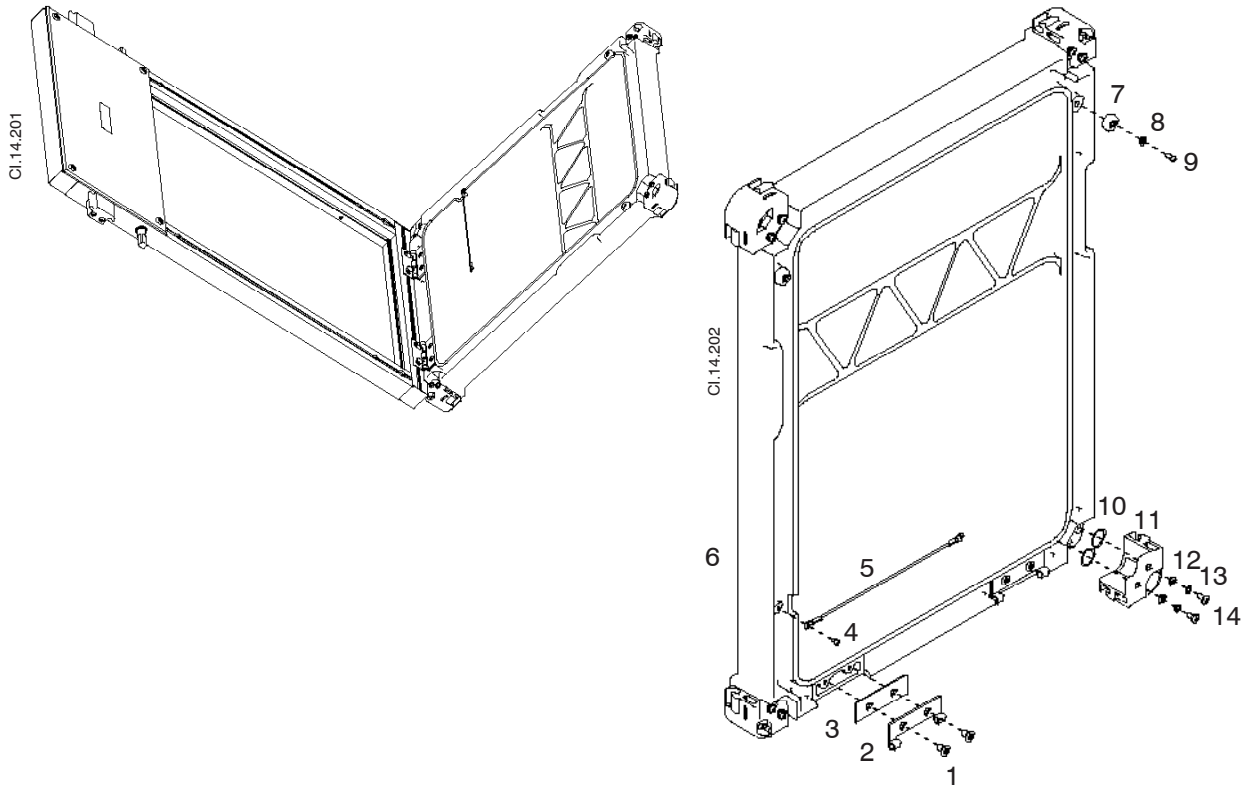


Figure 7-58
Model 3051 Mounting track and exhaust fans



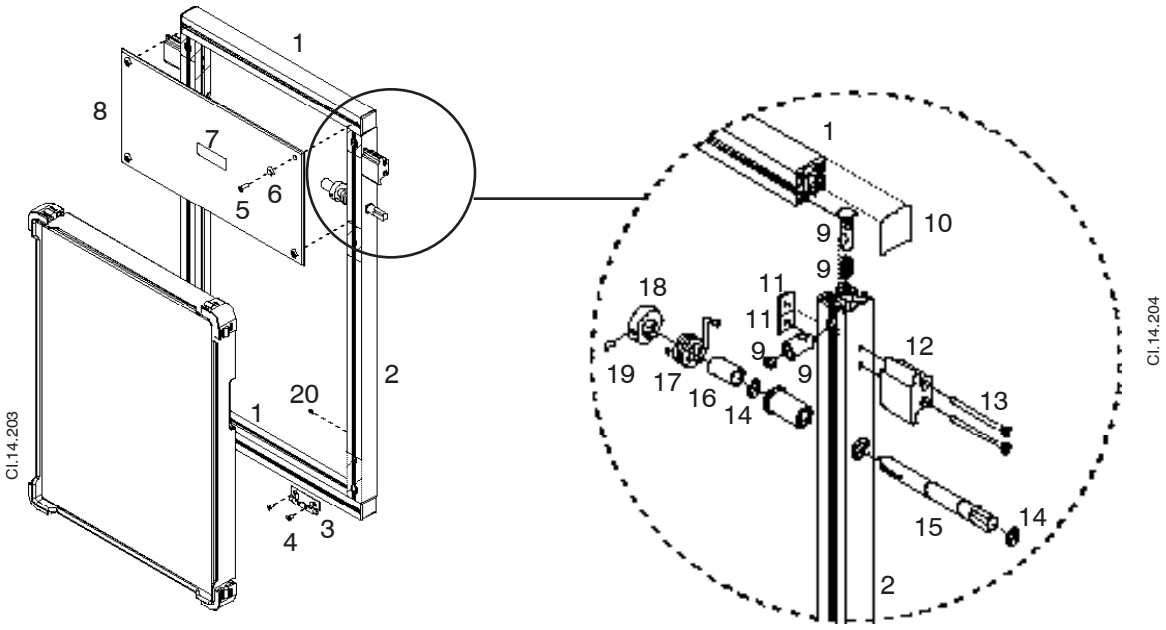
1.	Screw, 10-24 x 1/2" Flh Skt@	6600-0819-400
2.	Hinge, bed frame	6600-0576-700
3.	Hinge, spacer	6600-1084-500
4.	Screw, 6-32 x 1/4" Bhd Skt*	6600-0820-400
5.	Lanyard	6600-0813-400
6.	Bed, armoire	6600-1038-500
7.	Bumper	6600-1044-500
8.	Washer, flat 3/8"	6600-0797-400
9.	Screw, 8-32 x 5/8" Bdh Skt	6600-0801-400
10.	O-ring	6600-0348-400
11.	Corner block, grey(pkg.4 includes items 10, 12 13 &14)	6600-0228-801
12.	Washer, flat	0202-4518-340
13.	Lock washer, #10 split ring	6600-0322-400
14.	Screw, 10-24 x 3/8" Phillips@	6600-0250-400

*Torque to 7 + 1 lb. in.
@Torque to 15 + 2 lb. in.

Parts not shown

Front, rear bed side	6600-0004-855
Left, right bed side	6600-0004-853
Mattress	0305-5060-300
Velcro tape (10-1" pcs.)	6600-0839-200

Figure 7-59
Fold down bed parts



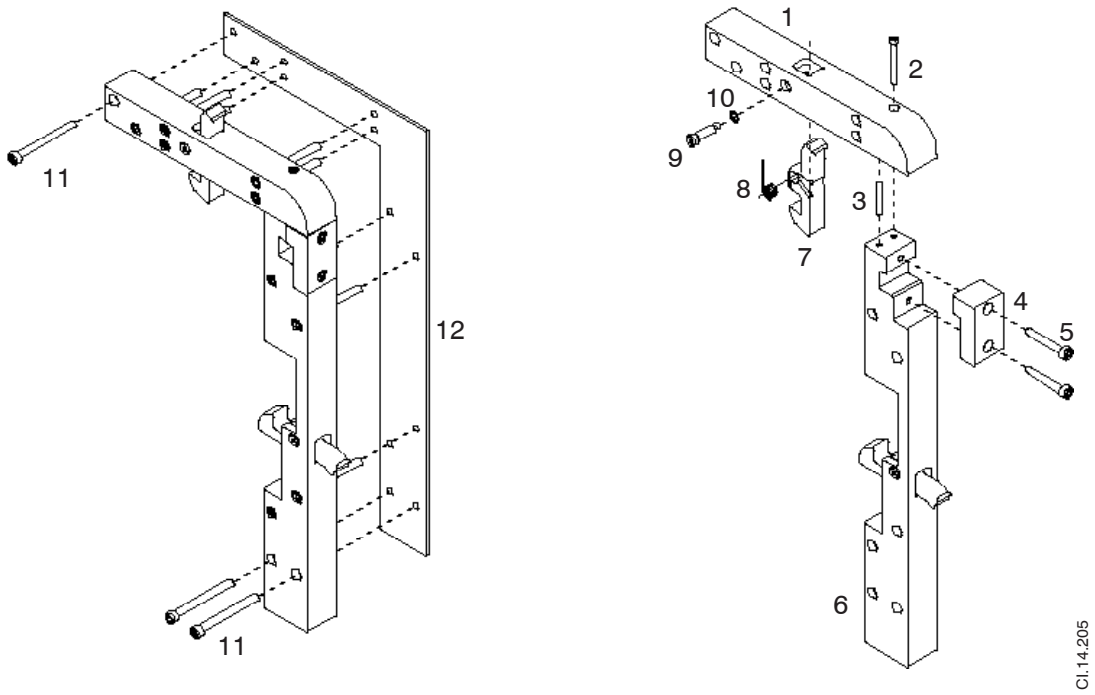
1.	Frame, top/bottom	6600-1068-500
2.	Frame, left side	6600-1069-501
	Frame, right side	6600-1069-502
3.	Hinge, bed frame	6600-0576-700
4.	Screw, M6 x 10 Fhd Skt @ *	6600-0708-419
5.	Screw,M6 x 20 Fhd Skt	6600-0708-422
6.	Washer, M-6 finishing	6600-0712-445
7.	Label, weight limit	6600-2288-101
8.	Vanity panel	6600-1063-500
9.	Frame connector (includes 4 parts shown)#*	6600-0811-400
10.	End cap	6600-1076-500
11.	M6 threaded plate	6600-0807-400
12.	Bed stop	6600-1074-500
13.	Screw, M6 x 80 Skt Hd Cap^ *	6600-0707-445
14.	Snap ring 5/8"	6600-0806-400
15.	Pivot rod	6600-1070-500
16.	Spring sleeve	6600-1097-500
17	Spring, left	6600-1073-501
	Spring, right	6600-1073-502
18.	Retaining collar	6600-1077-500
19.	Set screw, #8-32 x 1/2" ~*	6600-0829-400
20.	Screw, 6-32 x 1/4" Bhd Sk$	6600-0820-400

*apply loctite 242
@ Torque to 75 + 5 lb. in.
# Torque to 28 + 3 lb. in.
^ Torque to 110 + 14 lb. in.
~ Torque to 15 + 2 lb. in.
$ Torque to 7 + 1 lb. in.

Parts not shown

#10 x 1.75" Fhd wood screws	6600-0817-400

Figure 7-60
Fold down bed frame

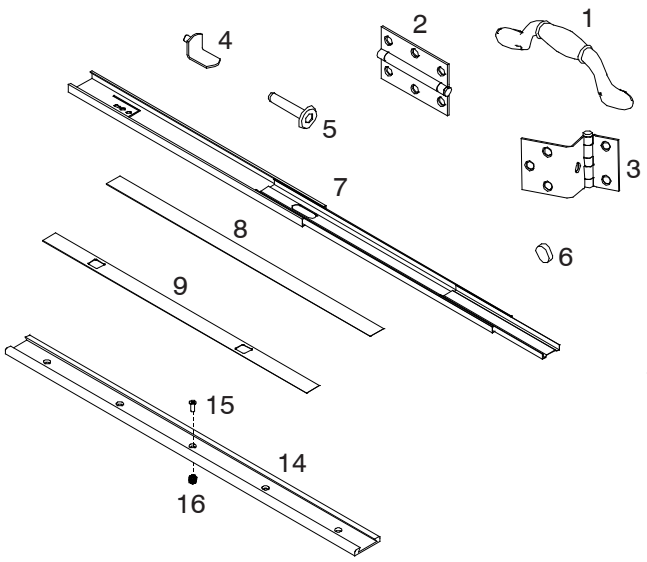


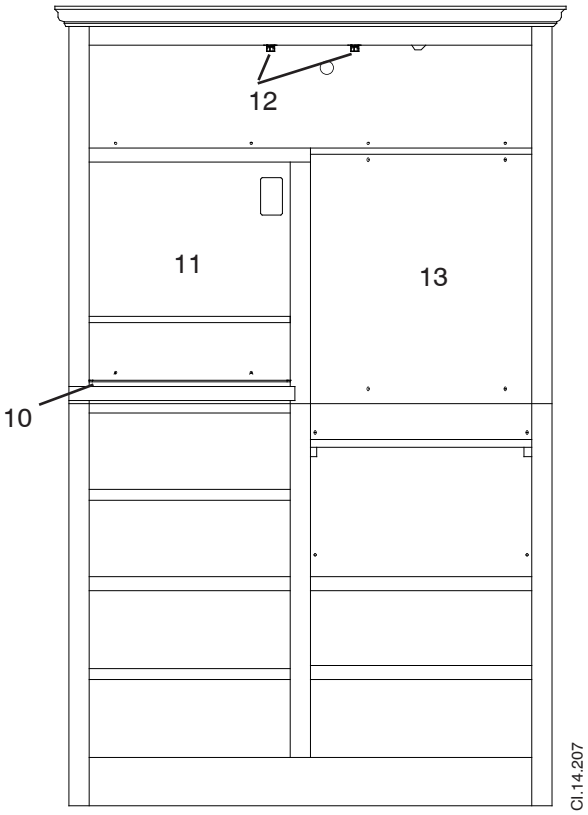
1.	Bracket, horizontal-right (latch)	6600-1067-500
	Bracket, horizontal-left (without latch)	6600-1501-500
2.	Screw, 6-32 x 1-1/4" Skt Hd	6600-0815-400
3.	Spring pin .125" x 1.0"	6600-0172-400
4.	Retaining block	6600-1079-500
5.	Screw, 10-24 x 1 1/4" Skt Hd	6600-0821-400
6	Bracket, vertical-right (latch)	6600-1066-500
	Bracket, vertical-left (without latch)	6600-1500-500
7.	Latch	6600-1088-500
8.	Torsion spring	6600-0823-400
9.	Screw, Shld #8-32*	6600-0825-400
10	Lock washer, #10 int	6600-0826-400
11.	Screw, #10-24 x 2" Skt Hd@	6600-0816-400
12.	Backing plate, right	6600-1071-502
	Backing plate, left	6600-1071-501

*23 + 4 lb. in
@ 50 + 10 lb.in

Figure 7-61
Fold down bed bracket

Cl.14.206, 225



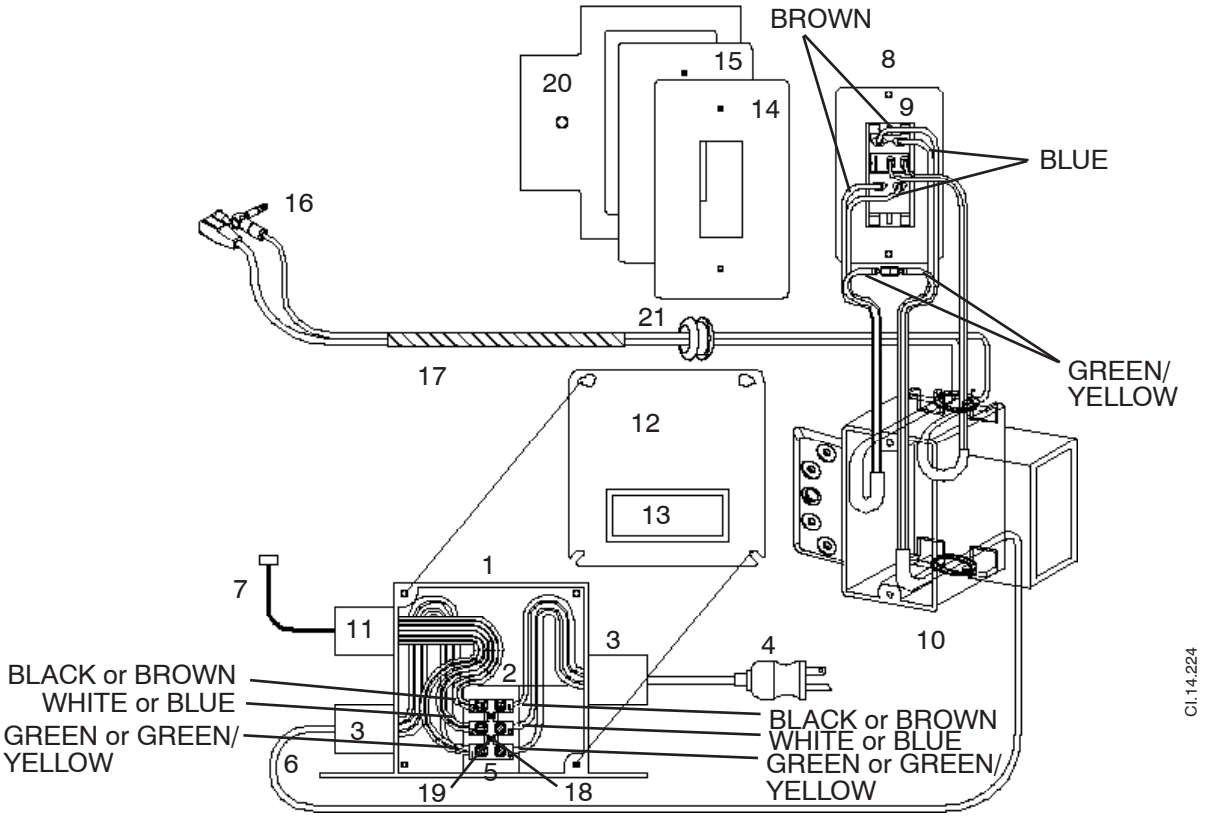


X as the last digit of the part number indicates wood shade:

X= 1 natural oak
2 bleached oak
3 medium oak
4 dark oak
5 cherry maple
6 natural maple
7 bleached maple
8 custom

1. Handle (traditional cabinet only) 6600-0825-20X
2. Hinge, butt 6600-0831-200
3. Hinge, wrap around 6600-0833-200
4. Shelf pin 6600-0838-200
5. Decorative screw
   1/4 - 20 x 1.181 (for 1/2" panels) 6600-0836-200
   1/2 - 20 x 1.378 (for 3/4" panels) 6600-0837-200
6. Bumper 6600-0835-200
7. Drawer slide (18") 6600-0832-200
8. Laminate strip 6600-0828-20X
9. Laminate strip, punched (latch side) 6600-0827-20X
10. Wooden peg 6600-0824-20X
11. Access panel, electrical
    (cabinets with warmer on right) 6600-0829-20X
    (cabinets with warmer on left) 6600-0881-20X
12. Door latch/catch 6600-0834-200
13. Access panel, gas
    (fold down bed, warmer on right) 6600-0830-20X
    (fold down bed, warmer on left) 6600-0882-20X
    (bassinet cabinets only) 6600-0892-20X
14. Accessory mounting rail 6600-1507-500
15 Screw, 8-32 x 1/2 Phillips head 6600-0834-400
16. Threaded insert 6600-0835-400

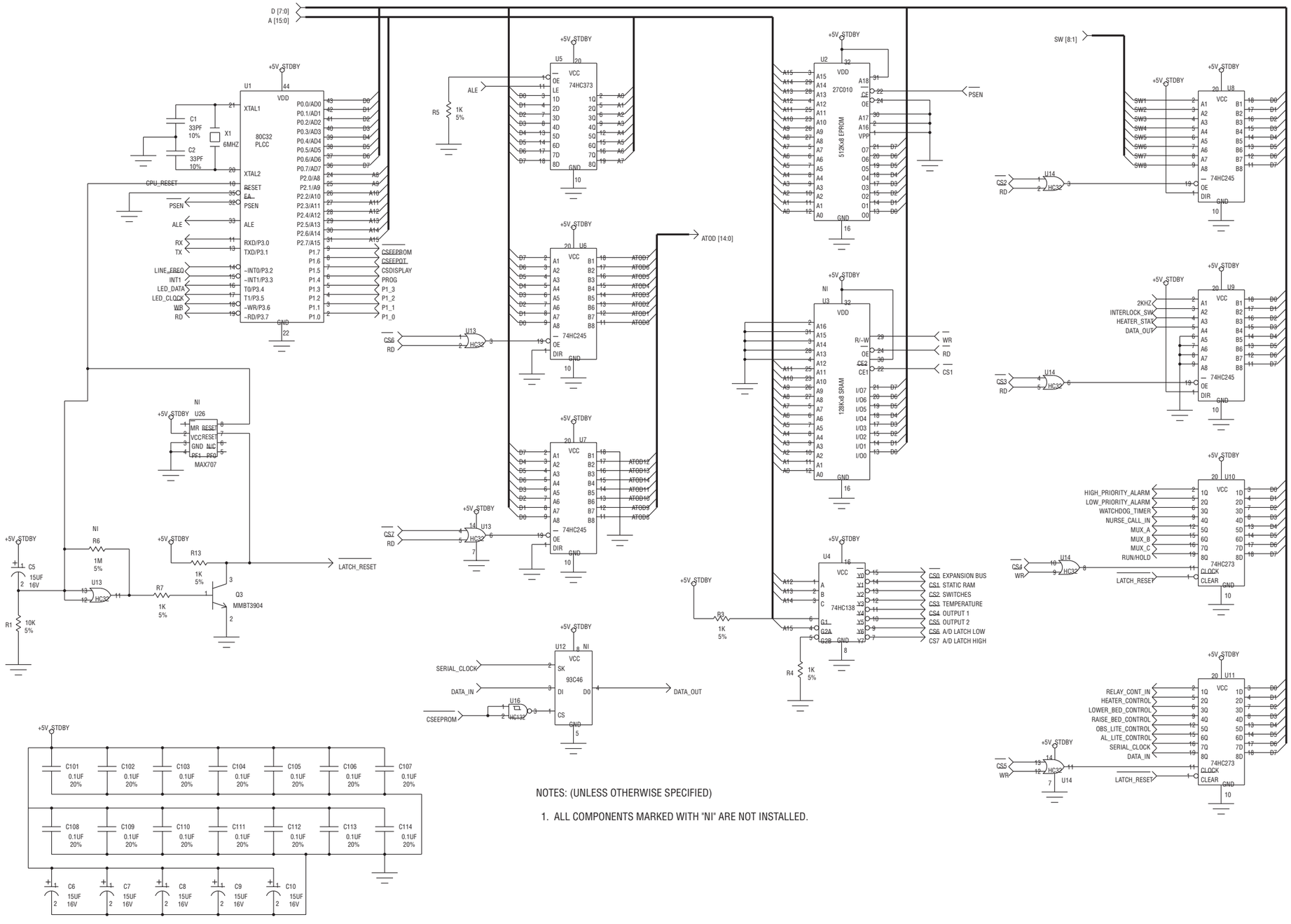
Figure 7-62
Armoire cabinet hardware



1.	Junction box	6600-1051-500
2.	Label, terminal block	6600-2282-101
3	Cable clamp	6600-0782-401
4.	Power cord	0208-0950-300
5.	Terminal block	6600-0819-600
6.	Cable set, power	6600-0825-600
7.	Harness, fan power	6600-0575-700
8.	Switch plate	6600-1078-500
9.	Power switch	6600-0818-600
10.	Switch box	6600-1050-500
11.	Cable clamp (.125)	6600-0782-402
12.	Junction box cover	6600-1052-500
13.	Label, danger, voltage	6600-0913-100
14.	Label, switch plate	6600-2279-101
15.	Switch cover	6600-1053-500
	Screw, M 3.5 x 32 oval head phillips	6600-0709-408
16.	Auxiliary power jack cable	6600-0821-600
17.	Cable wrap	6600-0783-400
18.	Screw, #4 x 1.00	6600-0799-400
19.	Washer,flat, #4	6600-0358-400
20.	Back plate	6600-1080-500
21.	Rubber grommet	6600-0804-400
Parts not shown		
	Wood screw, #10 x 1/2"	6600-0830-400

Figure 7-63
Armoire electical components

Notes



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL COMPONENTS MARKED WITH "NI" ARE NOT INSTALLED.

Figure 8-1a
Control Board Schematic-with software revision 06.00 and higher

8/Schematics

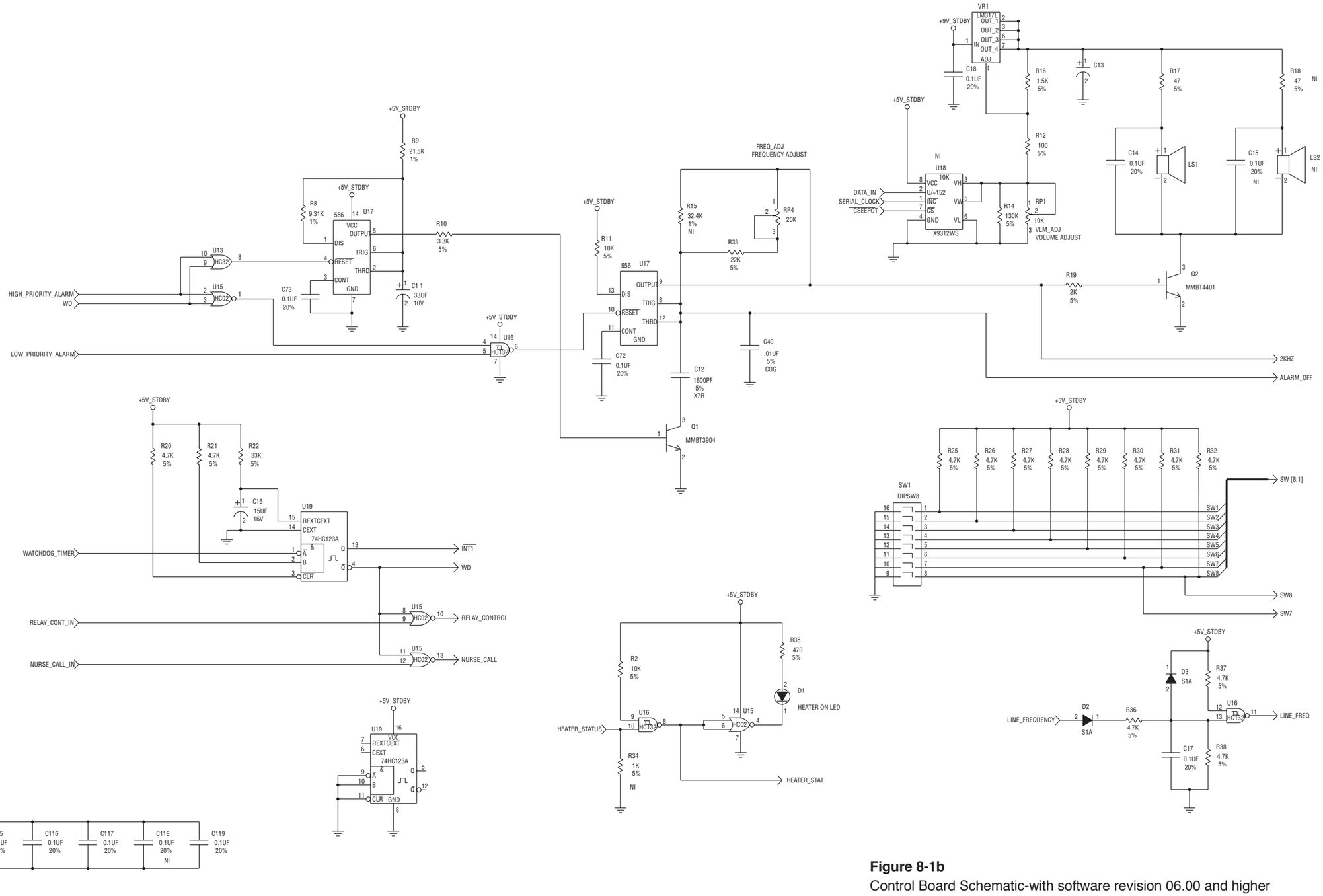


Figure 8-1b
Control Board Schematic-with software revision 06.00 and higher

8/Schematics

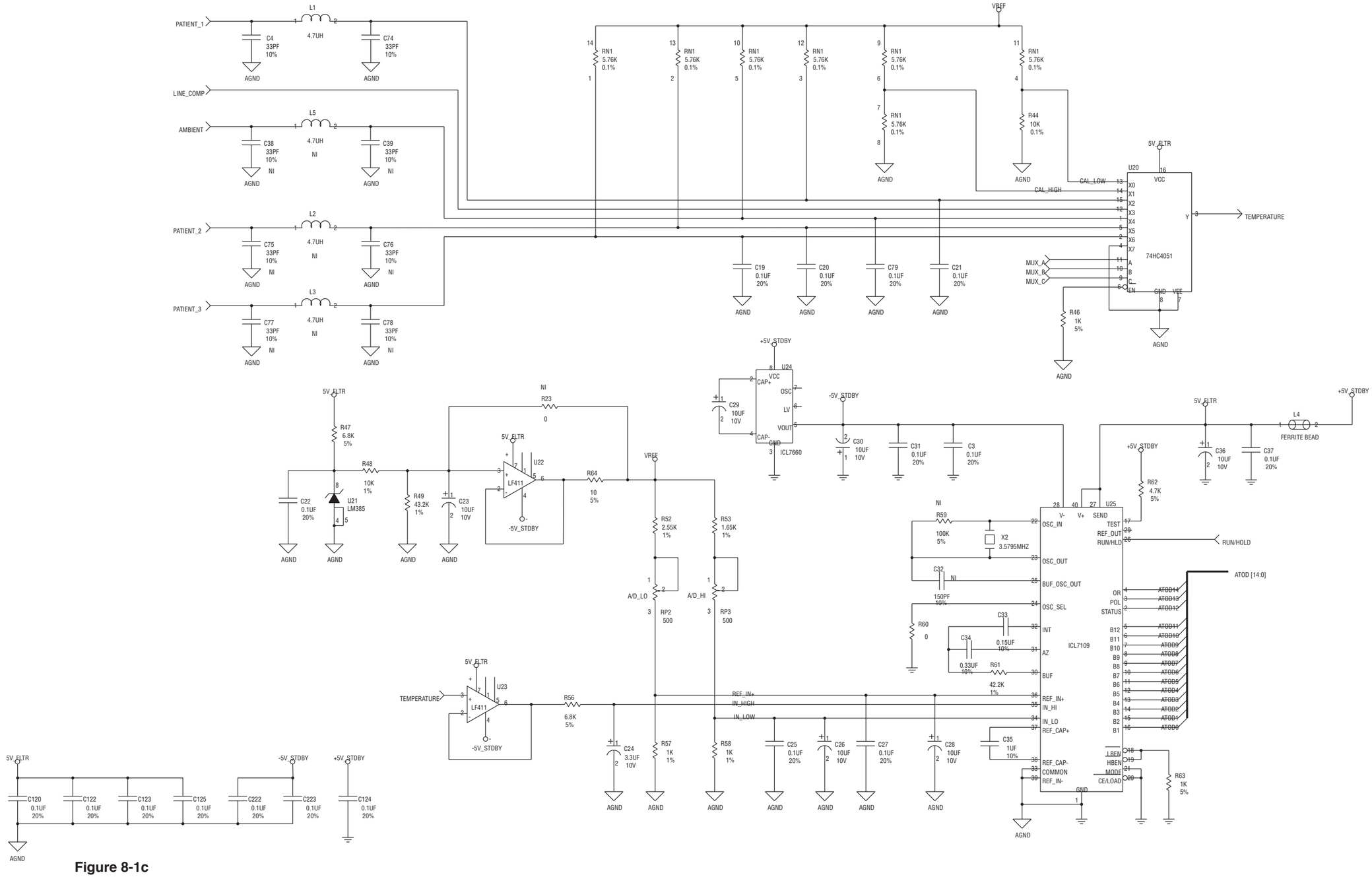
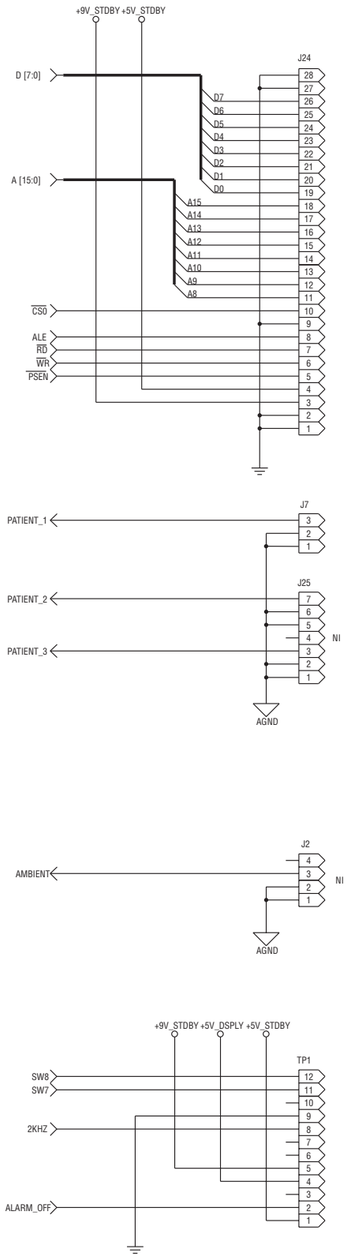


Figure 8-1c
Control Board Schematic-with software revision 06.00 and higher

8/Schematics



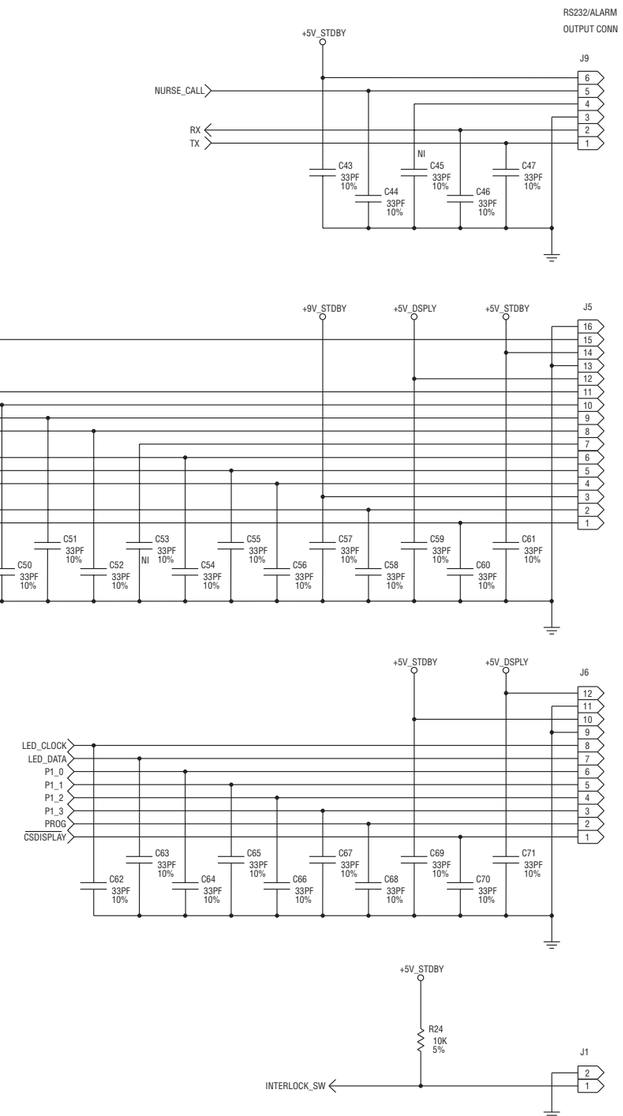
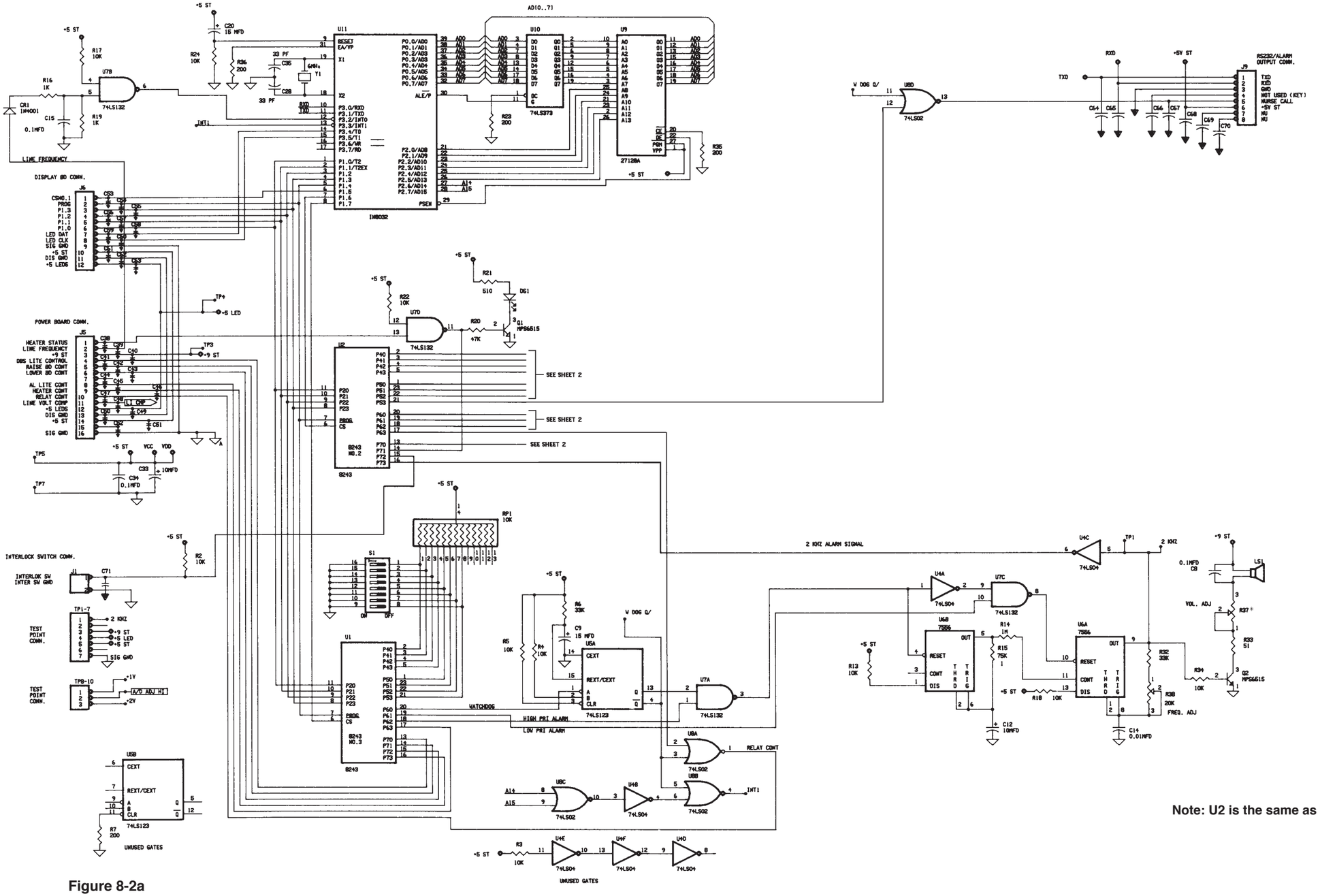


Figure 8-1d
Control Board Schematic-with software revision 06.00 and higher



Note: U2 is the same as U2 shown on sheet 2

Figure 8-2a
Control Board Schematic-units with ADC daughter board

CI.14.131

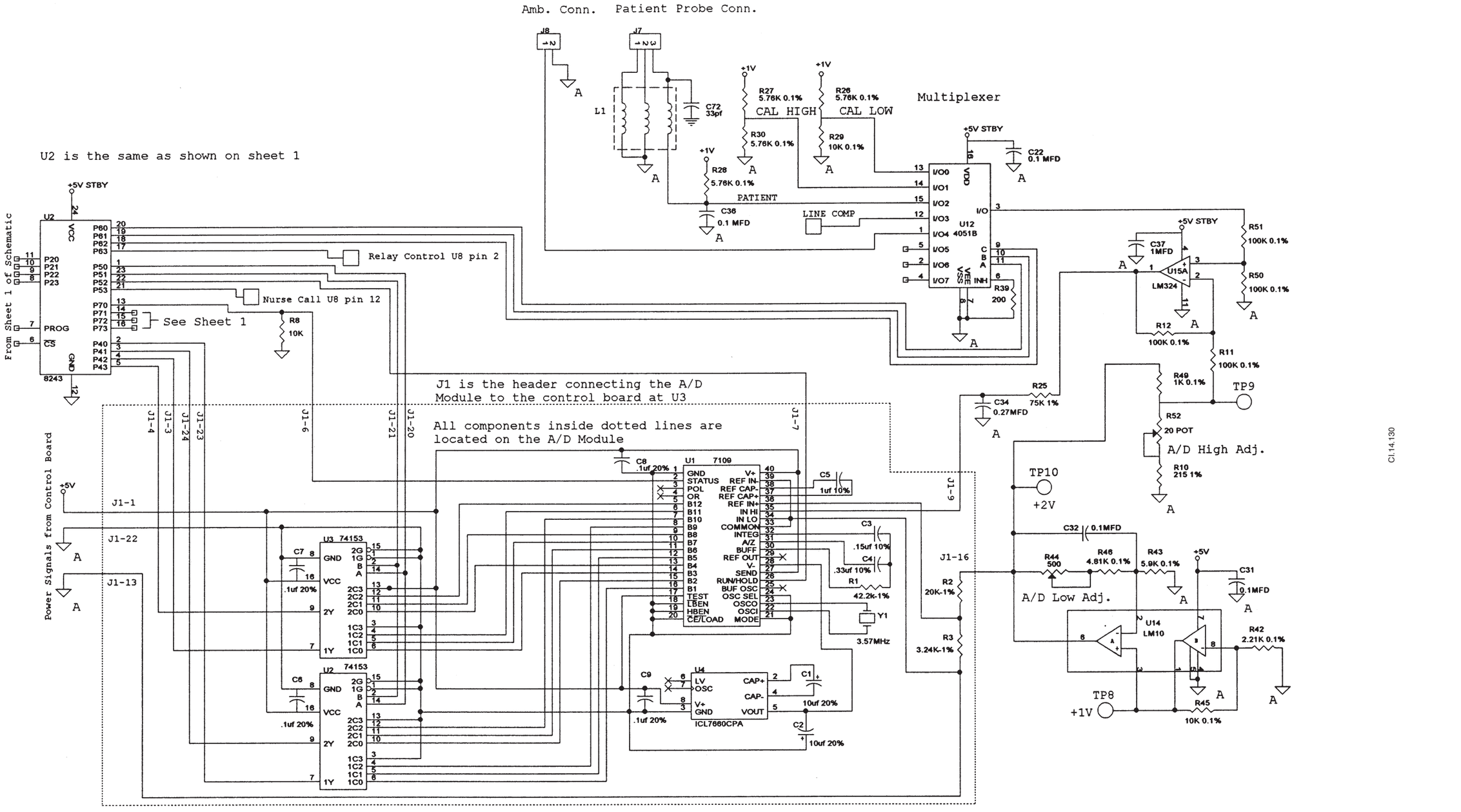


Figure 8-2b
Control Board Schematic-units with ADC daughter board

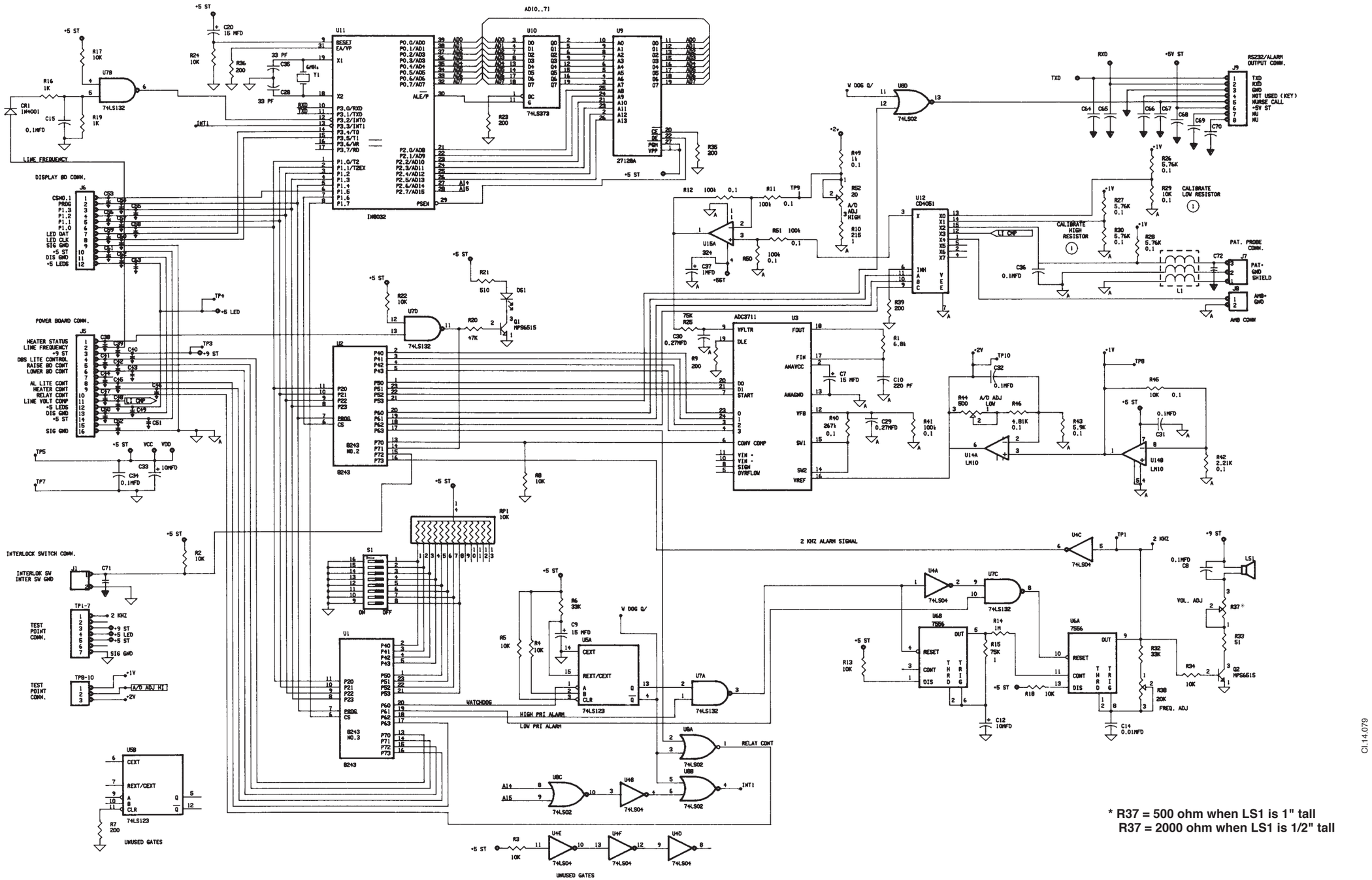
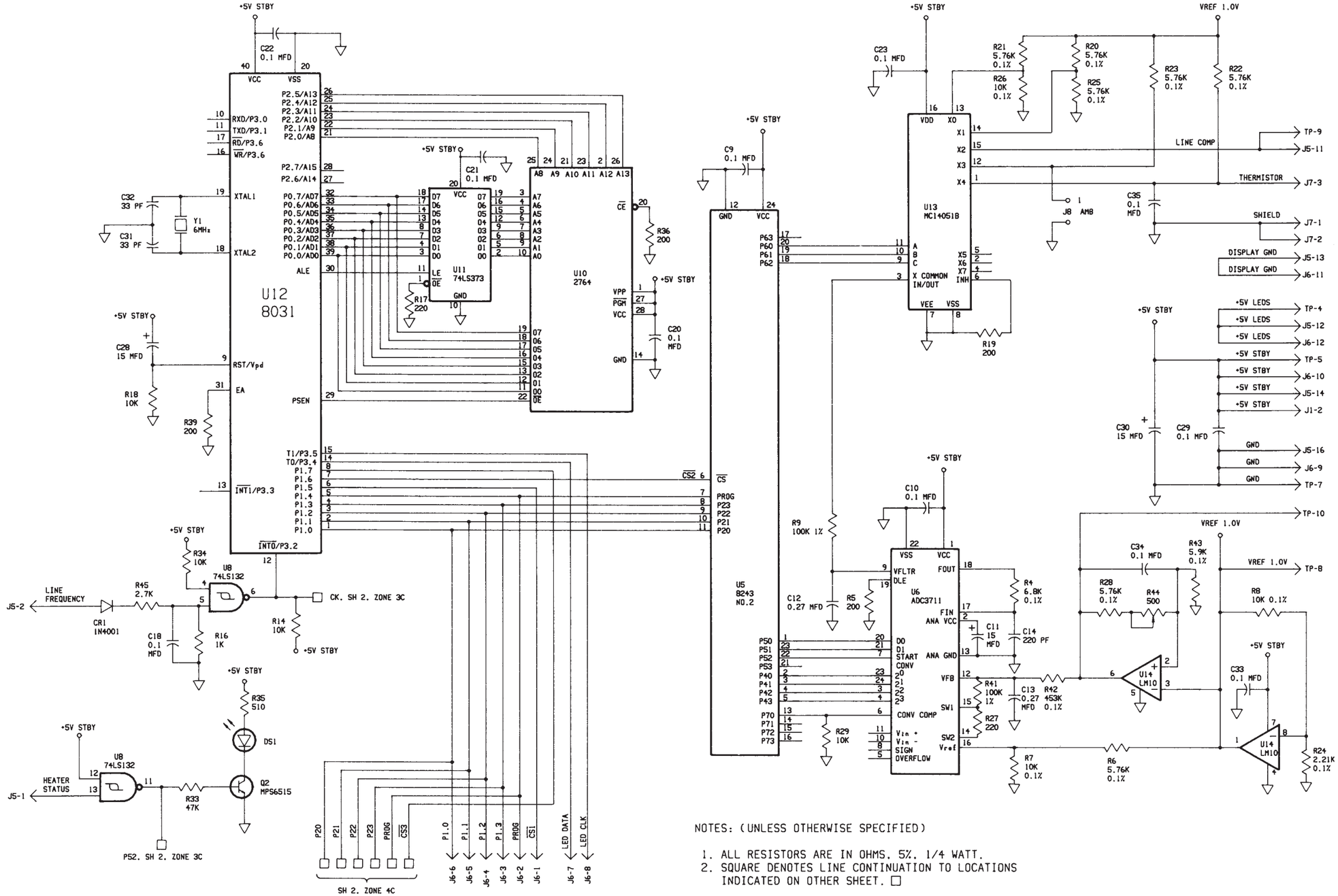


Figure 8-3
Control Board Schematic-units with software revision 04.01 through 05.10



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTORS ARE IN OHMS, 5%, 1/4 WATT.
2. SQUARE DENOTES LINE CONTINUATION TO LOCATIONS INDICATED ON OTHER SHEET. □

Figure 8-4a
Control Board Schematic-units prior to software revision 04.01

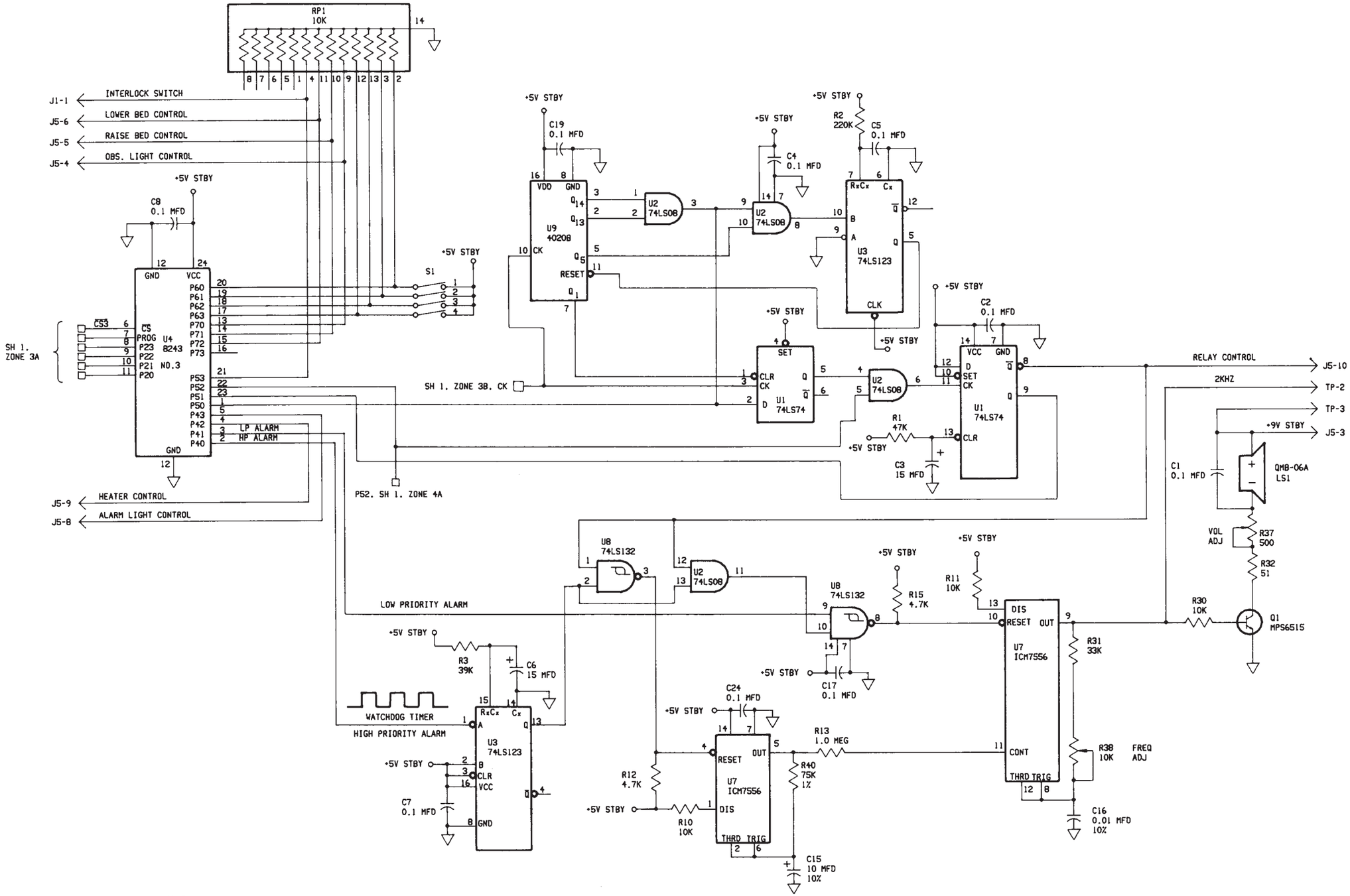


Figure 8-4b
Control Board Schematic-units prior to software revision 4.00

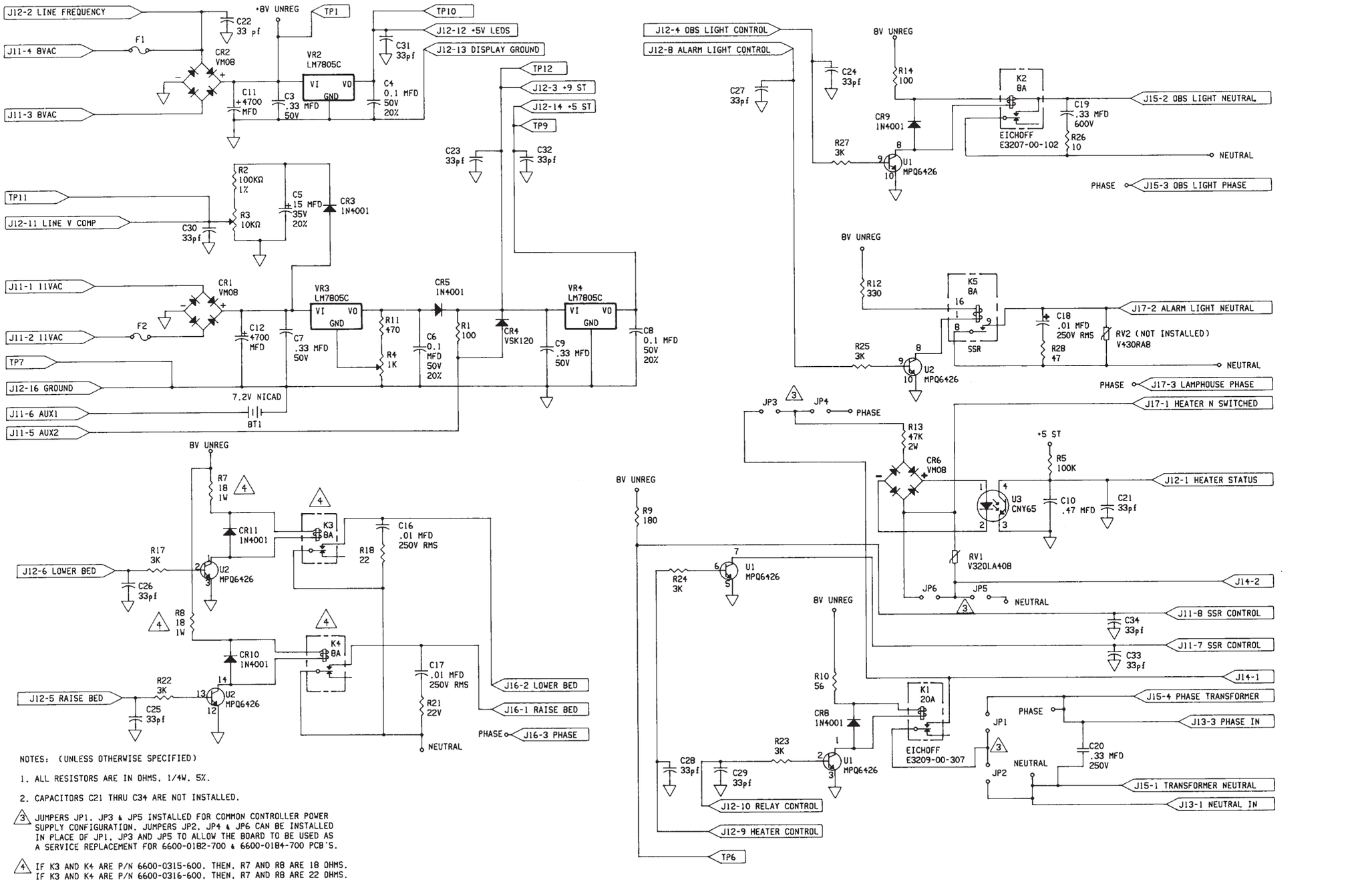
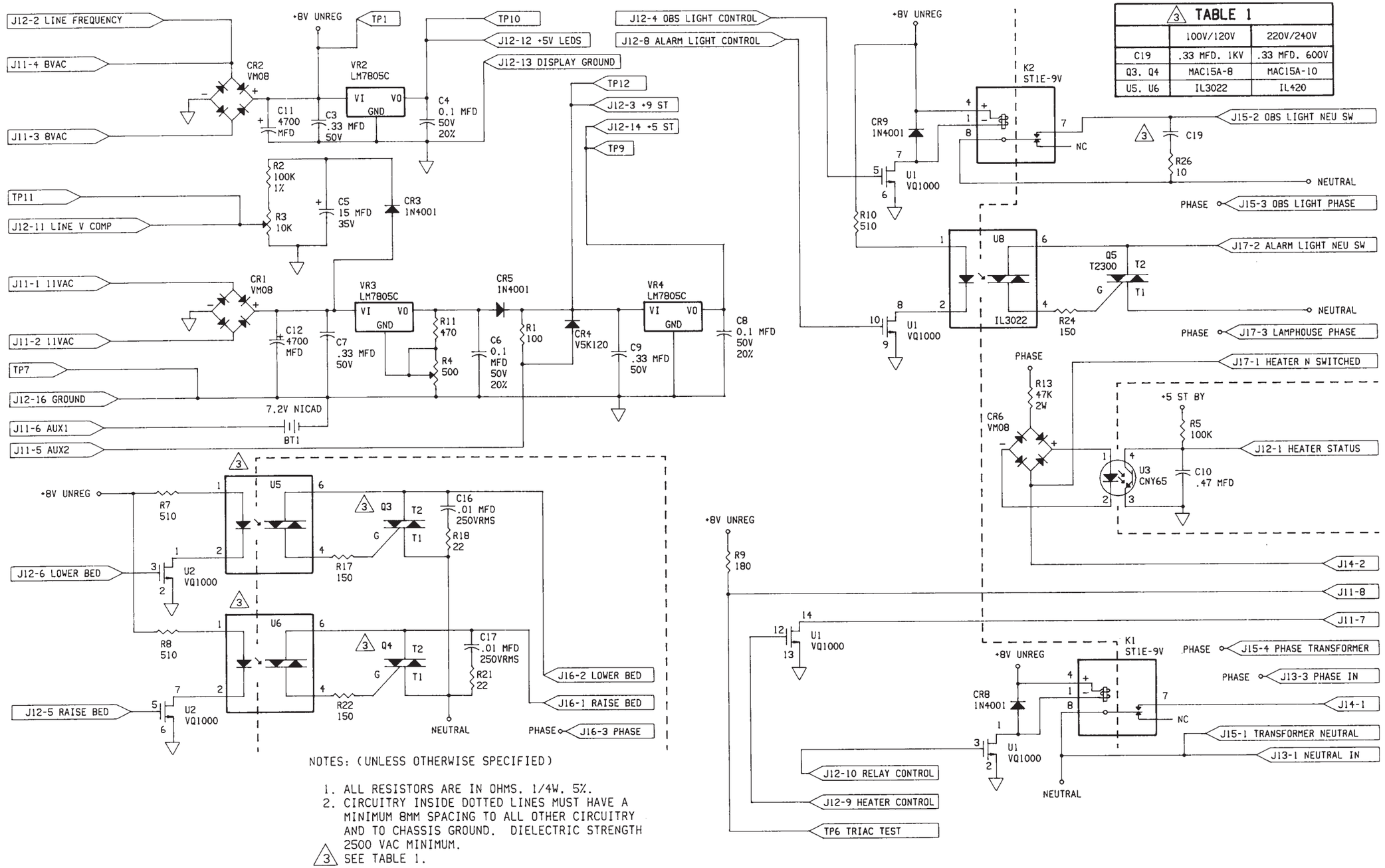


Figure 8-5
Power Supply Board controllers with HCA or HCC serial numbers



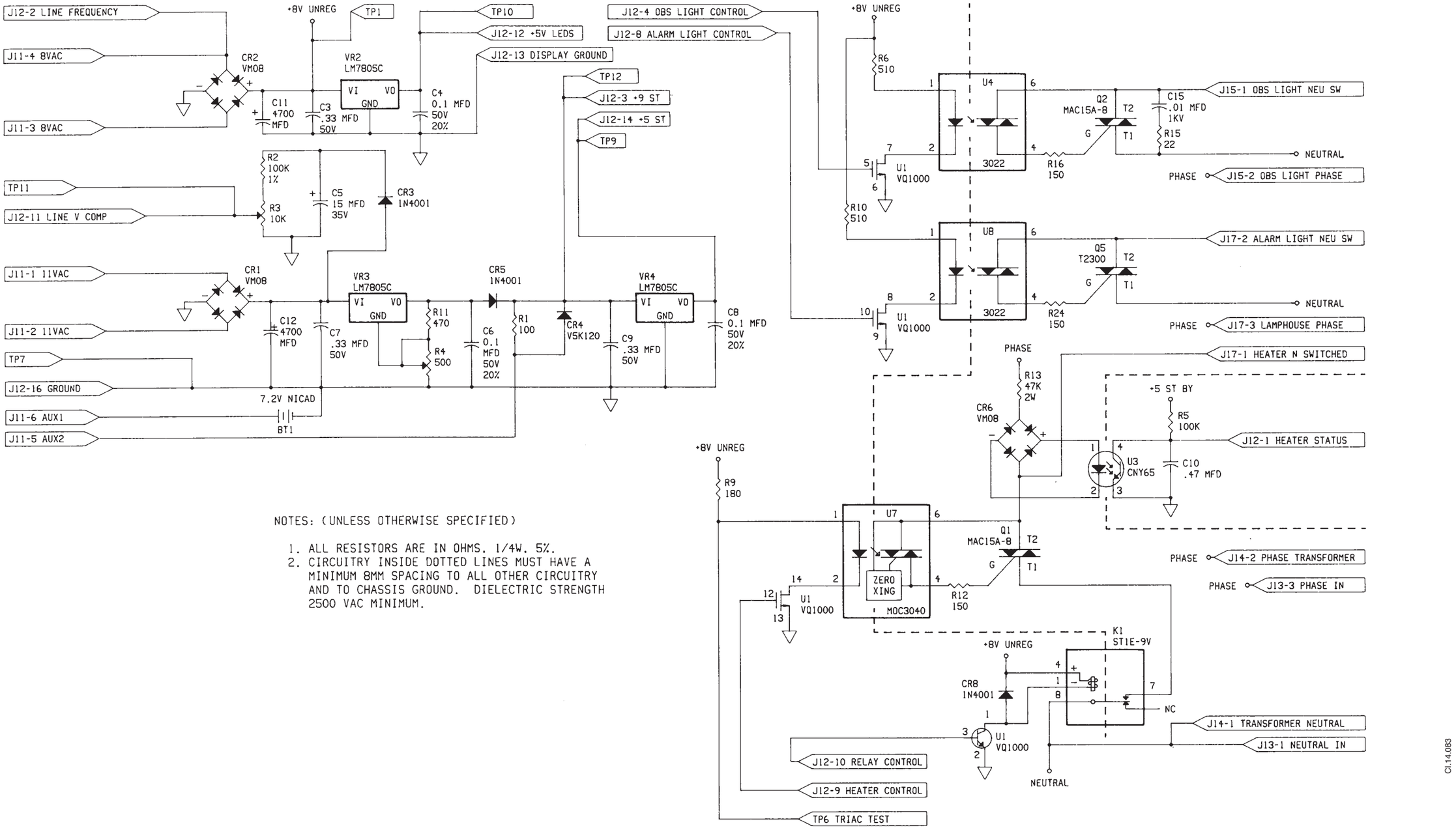
3 TABLE 1		
	100V/120V	220V/240V
C19	.33 MFD. 1KV	.33 MFD. 600V
Q3. Q4	MAC15A-8	MAC15A-10
U5. U6	IL3022	IL420

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTORS ARE IN OHMS. 1/4W. 5%.
2. CIRCUITRY INSIDE DOTTED LINES MUST HAVE A MINIMUM 8MM SPACING TO ALL OTHER CIRCUITRY AND TO CHASSIS GROUND. DIELECTRIC STRENGTH 2500 VAC MINIMUM.
3. SEE TABLE 1.

Figure 8-6
Power Supply Board Model 5000 with AAN serial number

Units with HAK, HAJ and AAN Serial No.



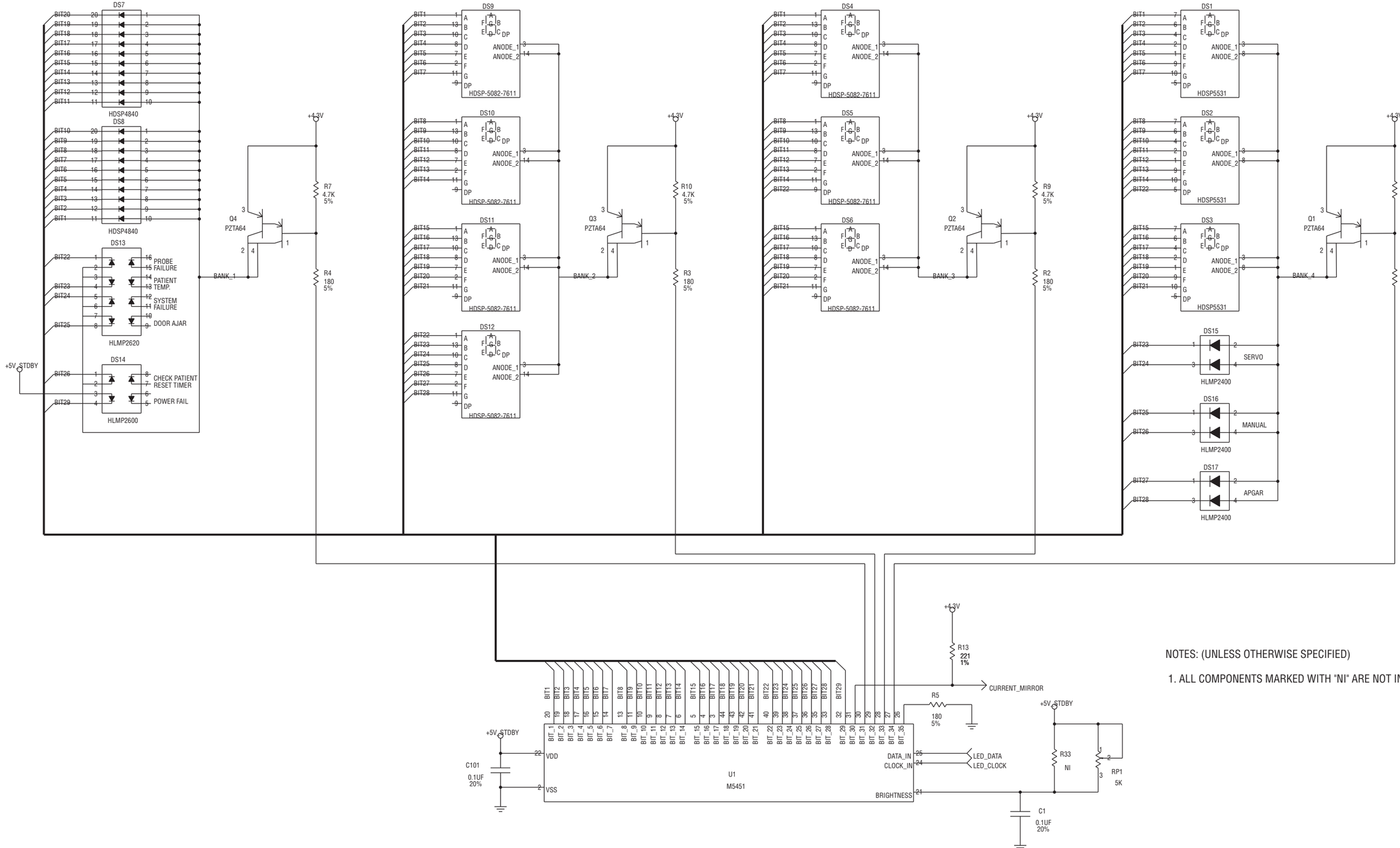
NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
2. CIRCUITRY INSIDE DOTTED LINES MUST HAVE A MINIMUM 8MM SPACING TO ALL OTHER CIRCUITRY AND TO CHASSIS GROUND. DIELECTRIC STRENGTH 2500 VAC MINIMUM.

CI.14.083

Figure 8-7
Power Supply Board Schematic- Model 2001 & Series 3000 with HAK, HAJ and AAN serial number

8/Schematics



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL COMPONENTS MARKED WITH "NI" ARE NOT INSTALLED.

Figure 8-8a
Schematic Display Board - Surface mounted board (SMT)

8/Schematics

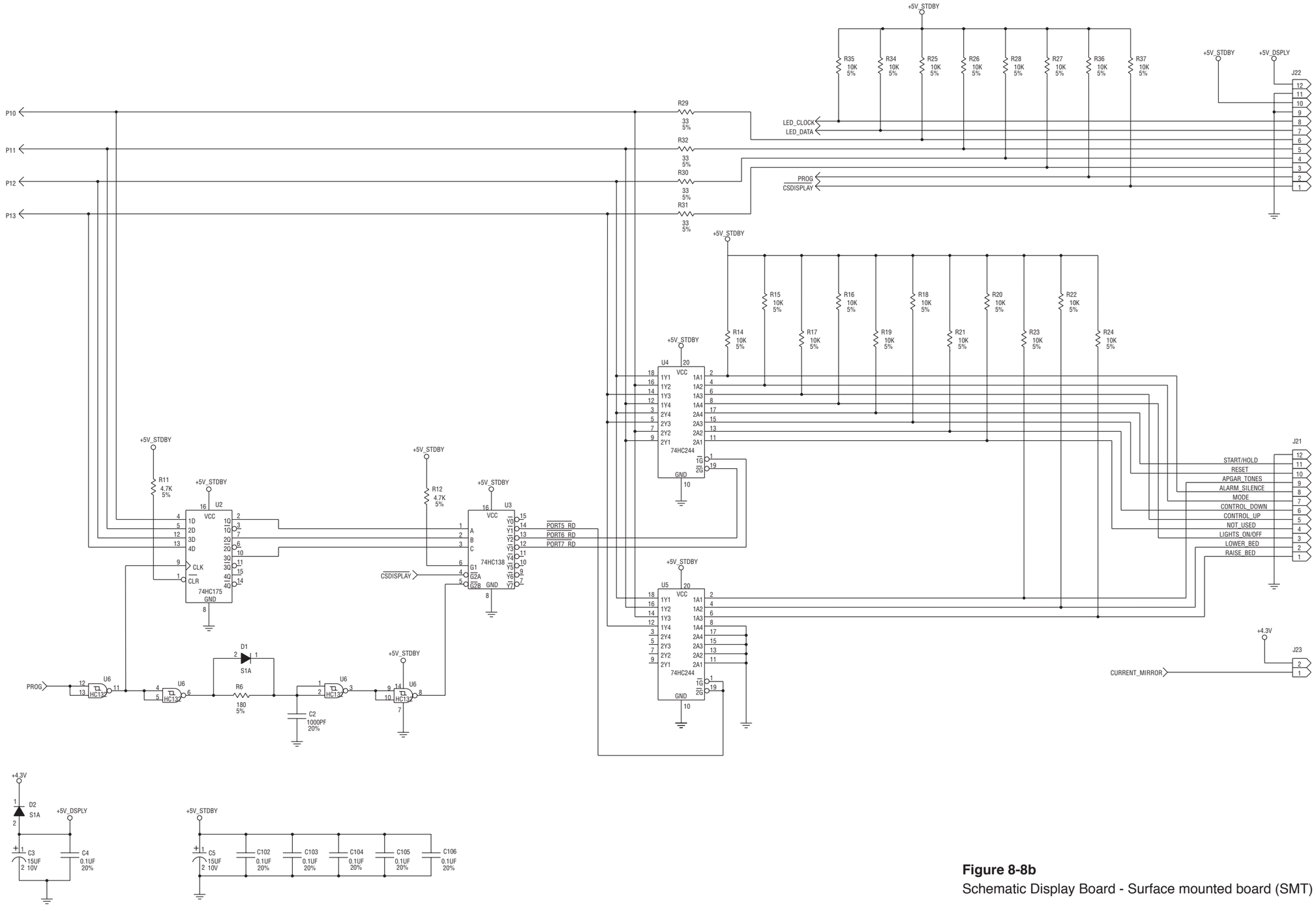


Figure 8-8b
Schematic Display Board - Surface mounted board (SMT)

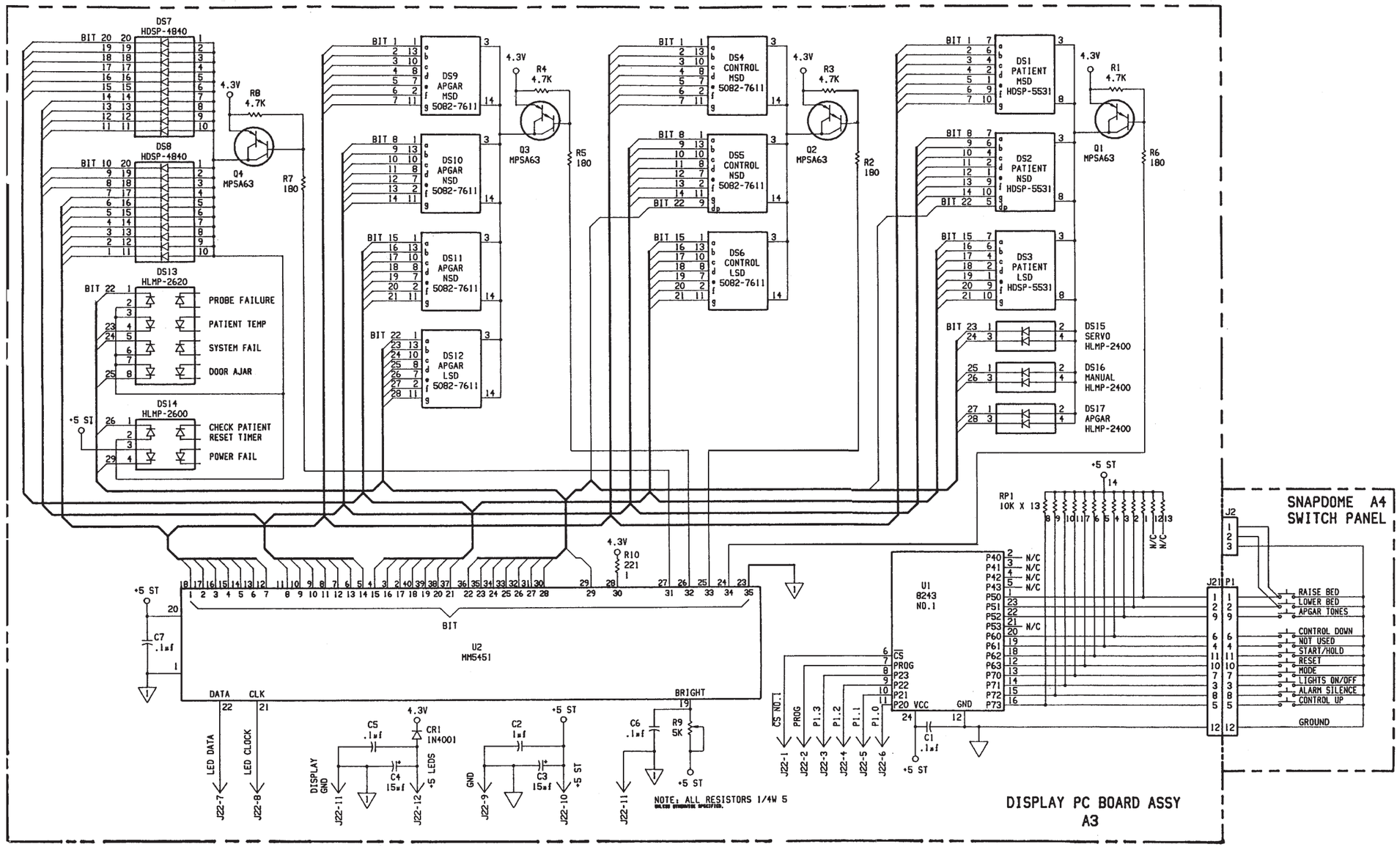
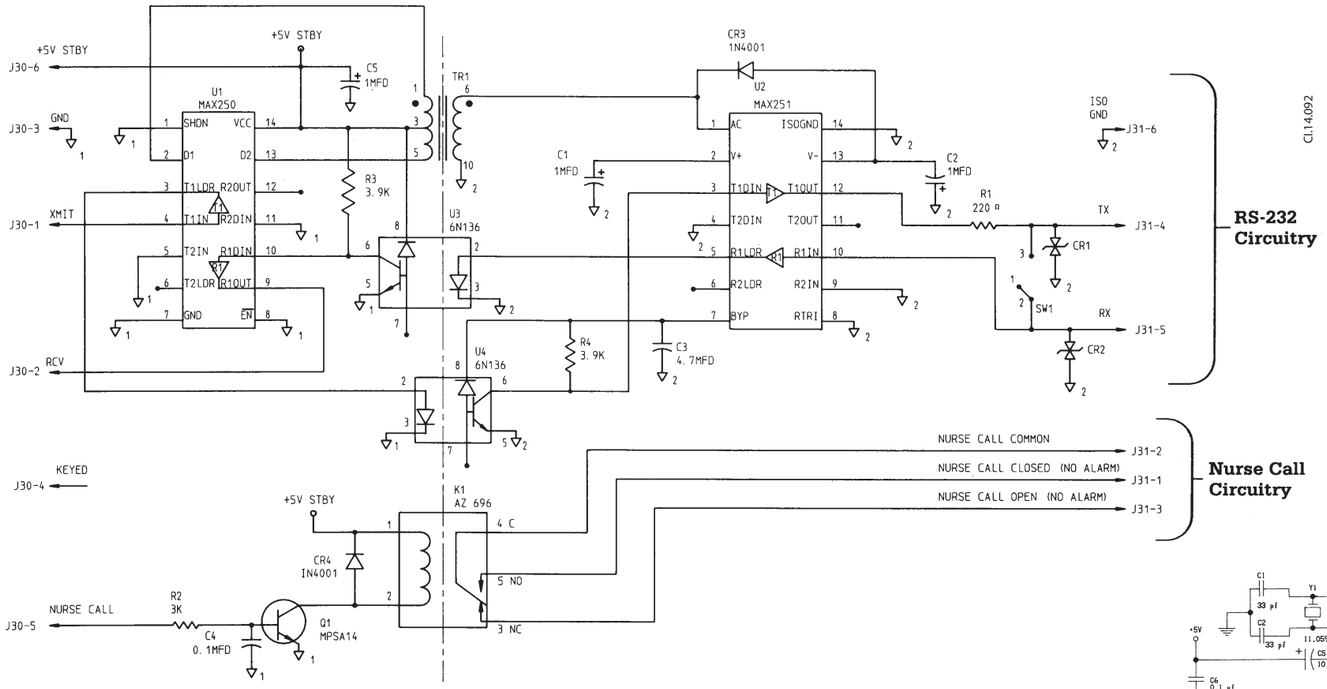


Figure 8-9
Schematic Display Board - through mount board



ThermaLink Boards with test switch

ThermaLink Boards without test switch

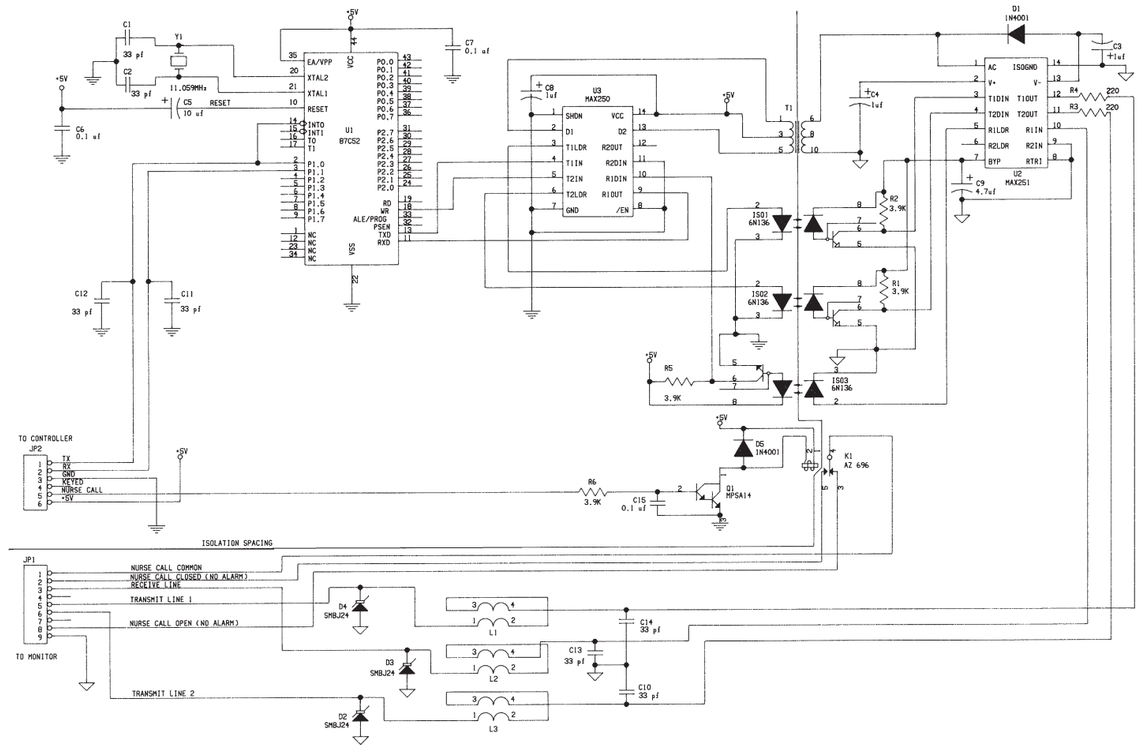


Figure 8-10
ThermaLink Schematic

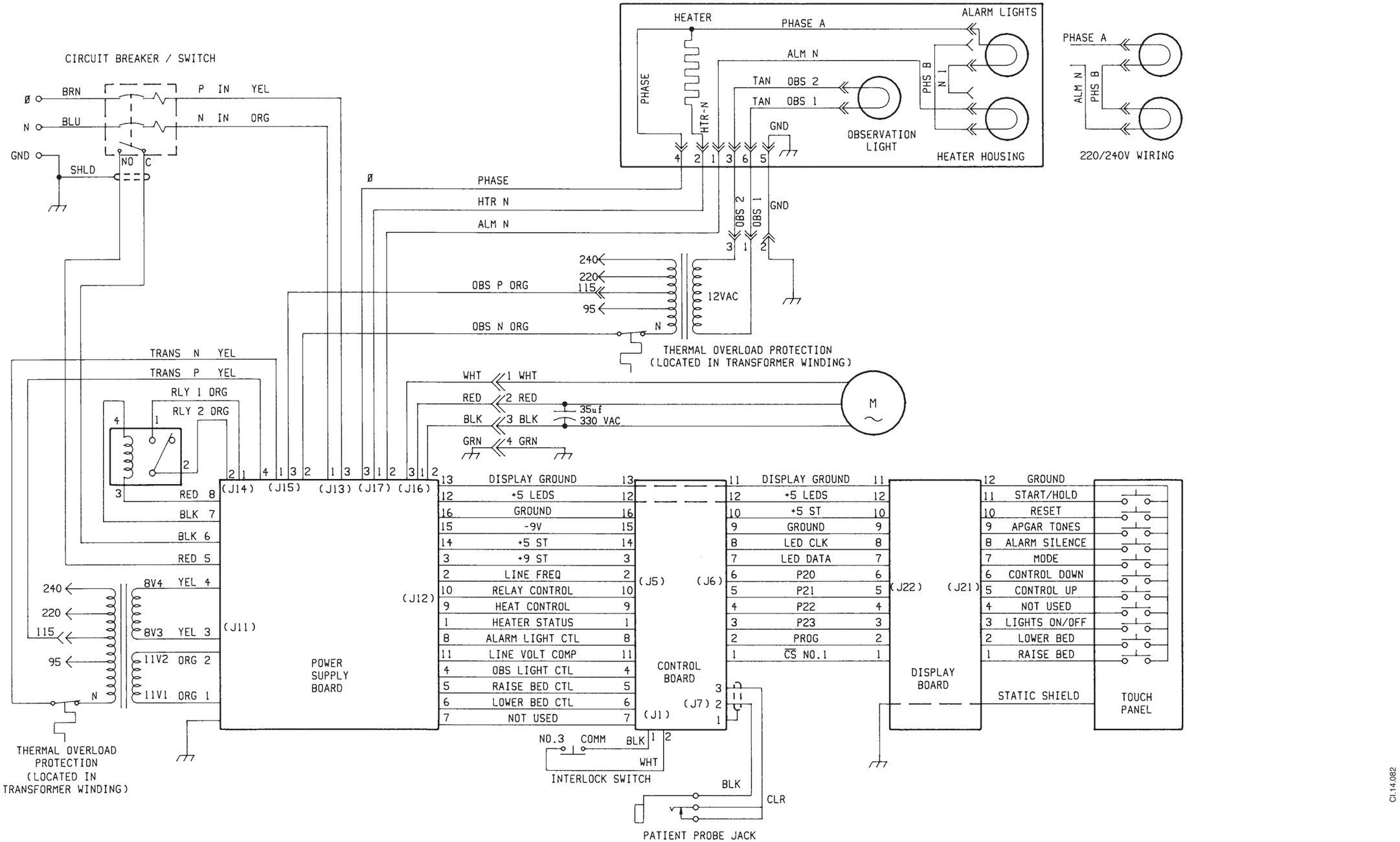


Figure 8-11
Wiring Diagram - Model 5000 with AAN serial number

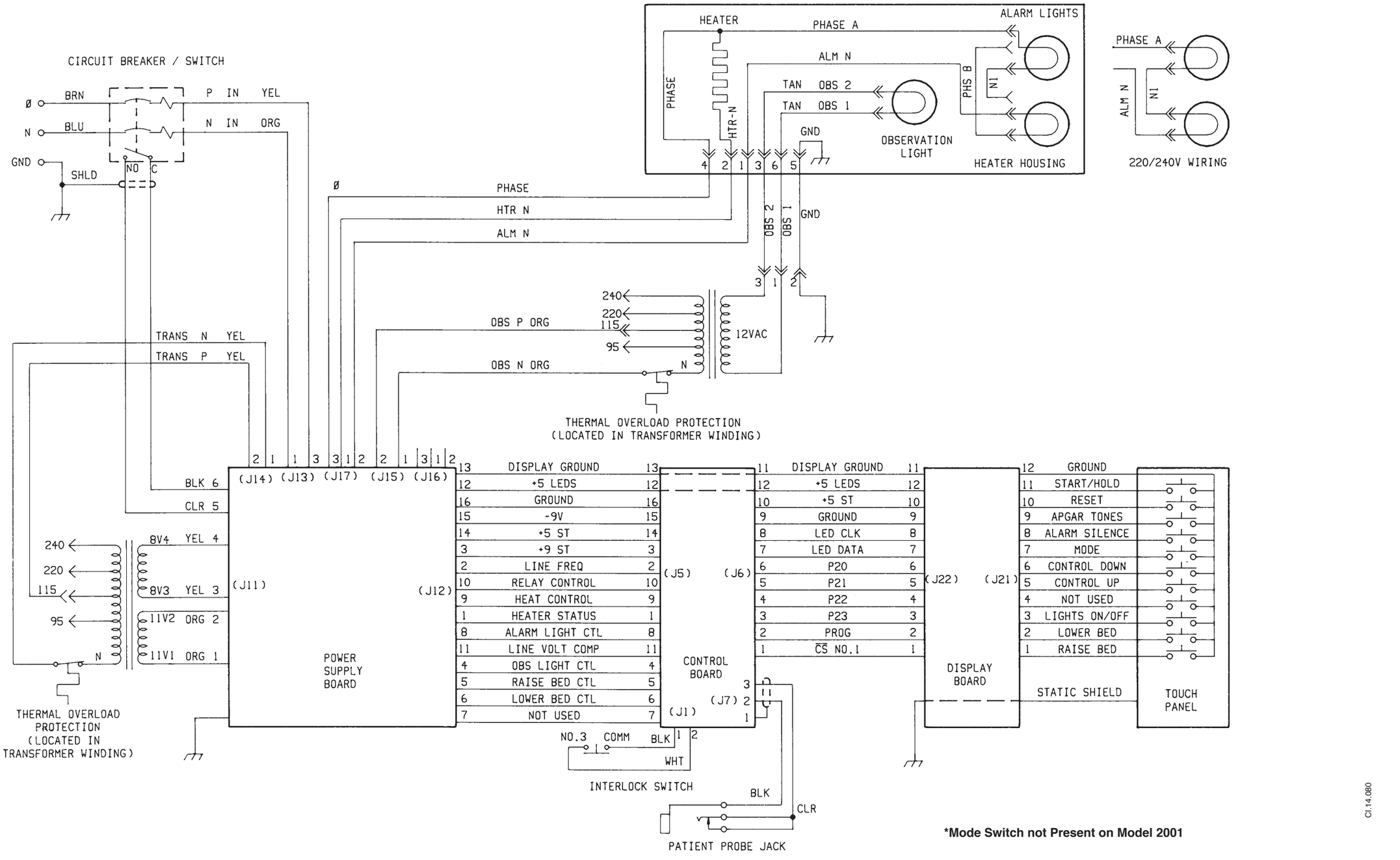


Figure 8-12
Wiring Diagram - Model 2001 and Series 3000 with HAK, HAJ and AAN serial numbers

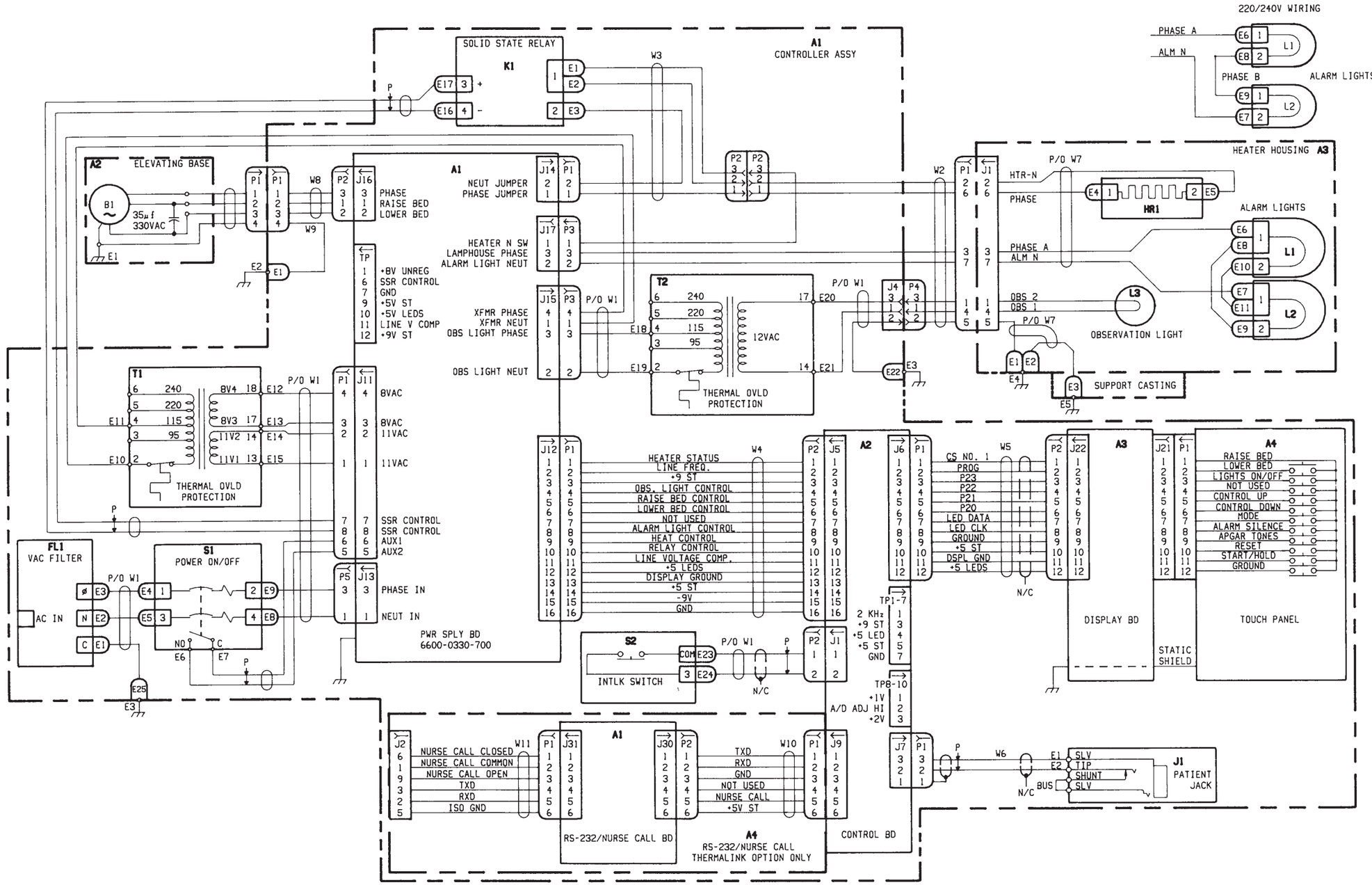
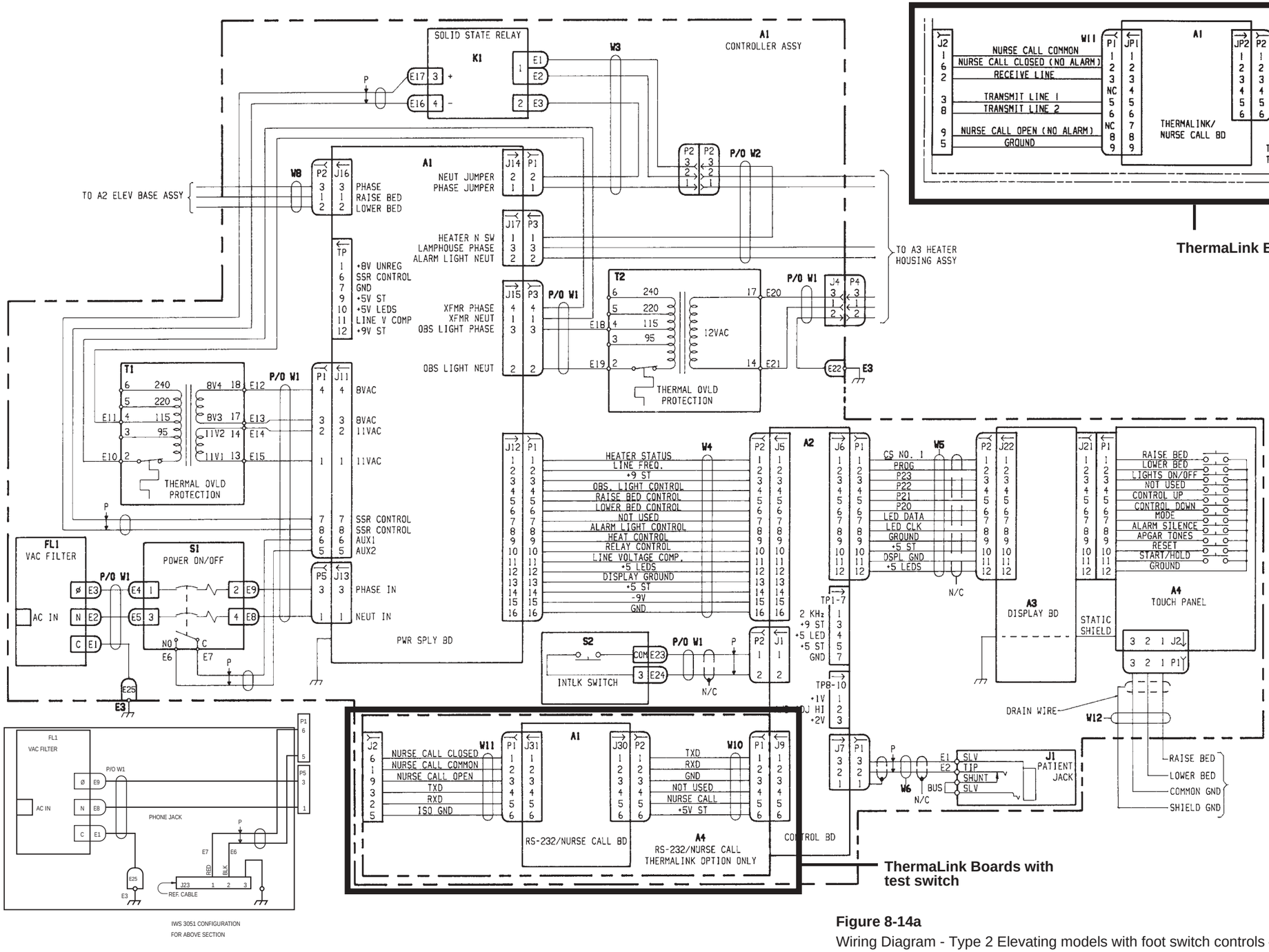
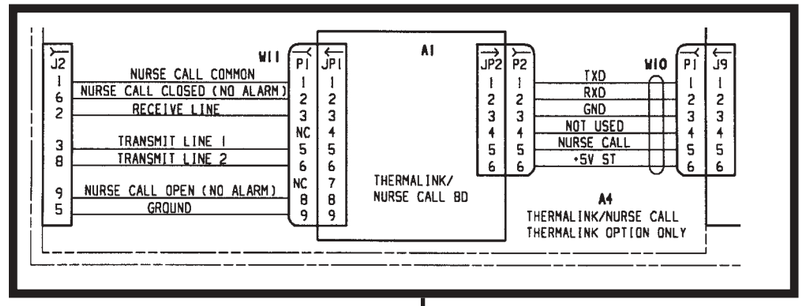


Figure 8-13
Wiring Diagram - Units with HCA serial number





ThermaLink Boards without test switch

Figure 8-14a
Wiring Diagram - Type 2 Elevating models with foot switch controls — page 1

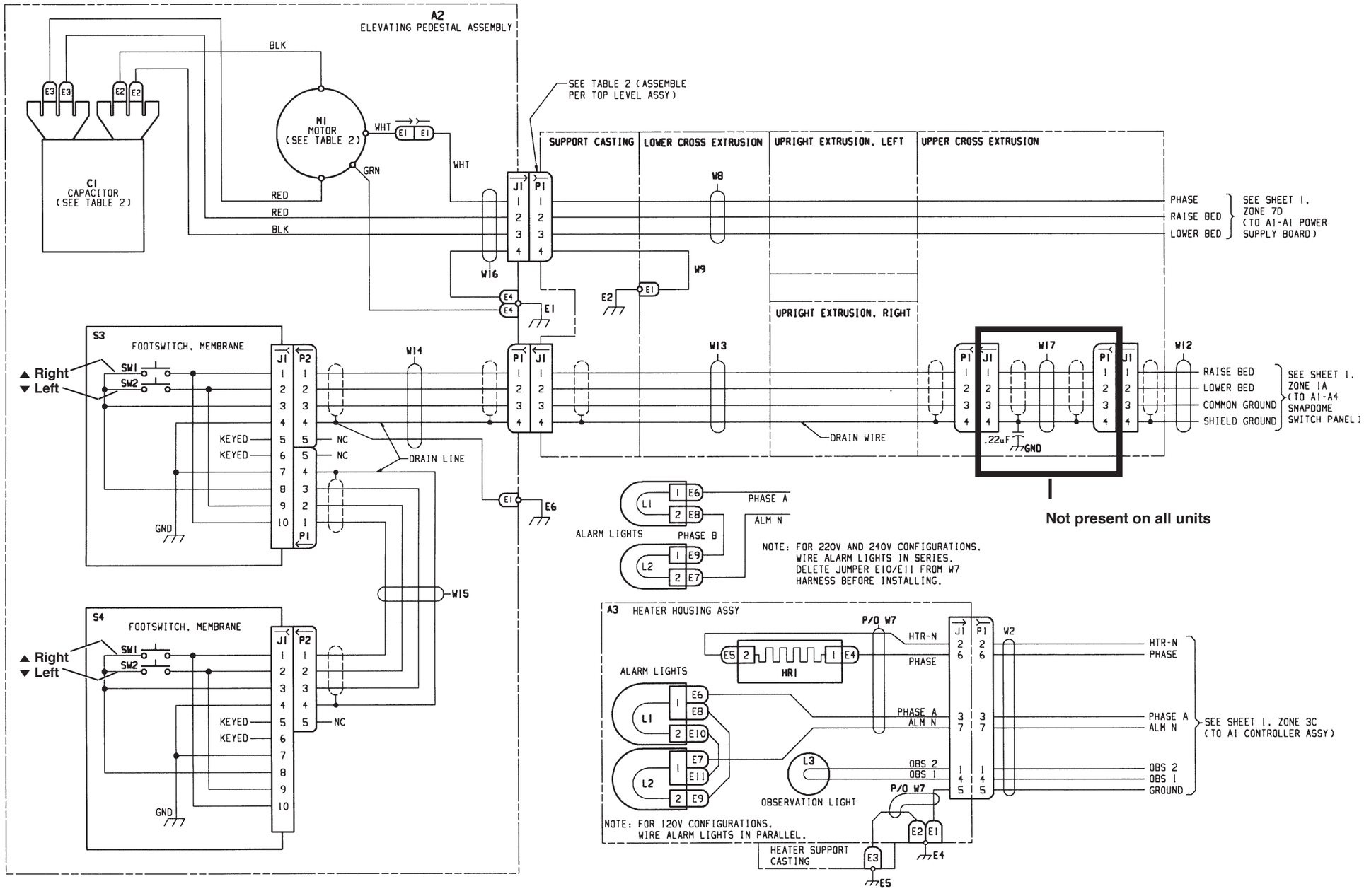


Figure 8-14b
Wiring Diagram - Type 2 Elevating models with foot switch controls — page 2

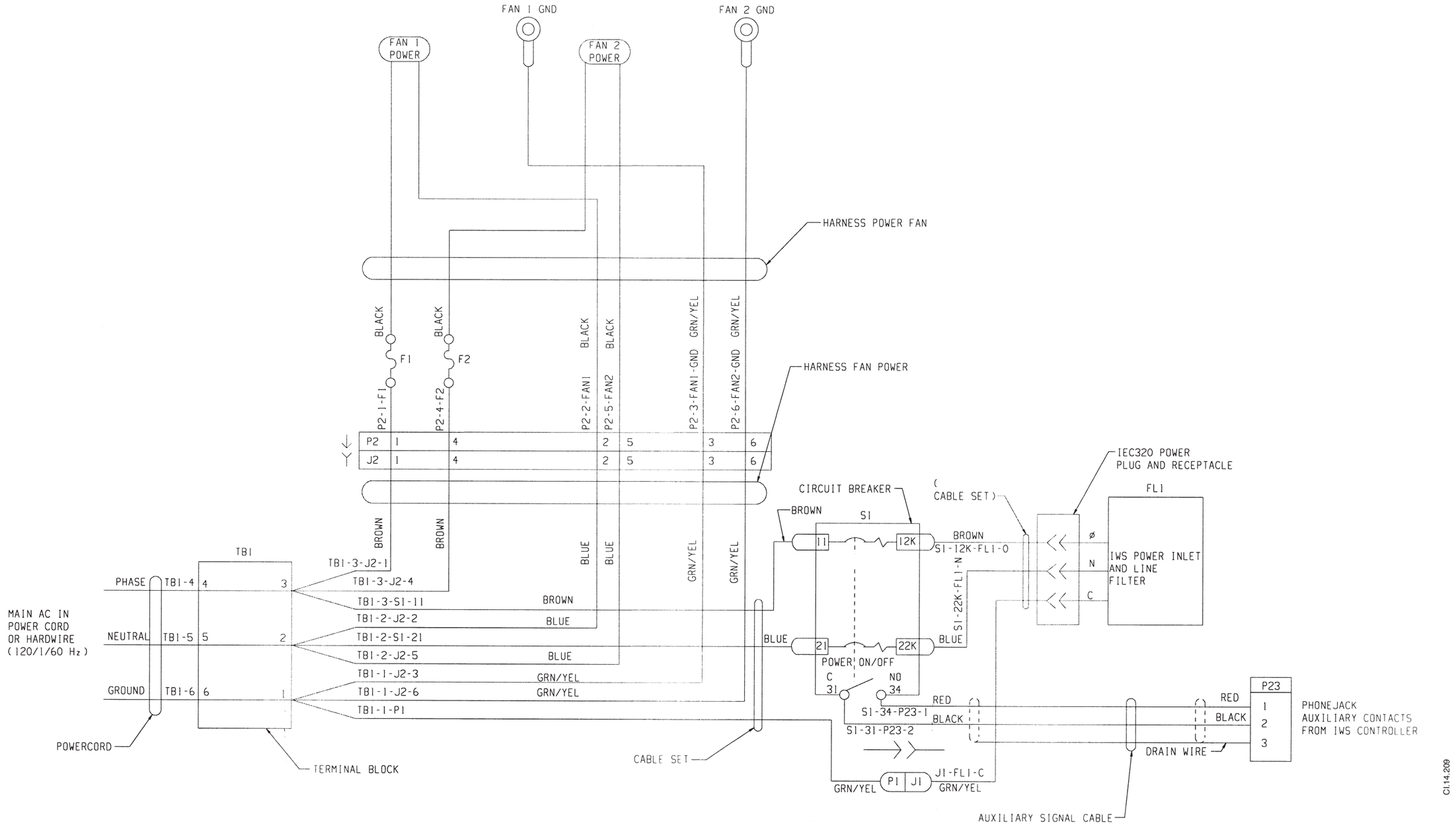


Figure 8-15
Wiring Diagram - Armoir cabinet units

A.1 Test Equipment and Reference Tables

A. Test Equipment and Special Tools

The following tools (or their functional equivalents) are required to complete the recommended service procedures. If you do not have these items, they can be ordered from Ohmeda.

Description	Stock Number
Digital Multimeter, 3 1/2 digit	7000-0000-023
Leakage Current Tester with AAMI Test Load	0175-2305-000
Static Control Work Station, 3M Model 8005 or Equivalent	0175-2311-000
Beige touch-up paint (Munsell No. 10Y9-1) 8 Oz.	0220-0211-300
Light grey touch-up paint (Munsel 1GY8.56-0.44 chroma)	6600-0714-200

Optional items include:

Oscilloscope, 15 MHz Dual Trace Scope	0175-2302-000
Ohmeda Temperature Simulator	0217-2788-800
DB9 Male Test Connector (Pins 2 & 3 shorted)	6050-0001-709

For units equipped with gas package only:

Yoke check valve socket	0175-0420-000
Air/O_2 Test tool	
Tee 1/8 NPT Female	6700-0134-400
Adapter 1/8 NPTM-1/8 Hose Barb	0204-8877-300
Gauge 100 PSI	0205-8201-300
Orifice .025"	7000-0000-103
1/8" Tygon Tubing	0994-6370-010
DISS HIT Oxygen	6700-0510-800
DISS HIT Air	6700-0510-803

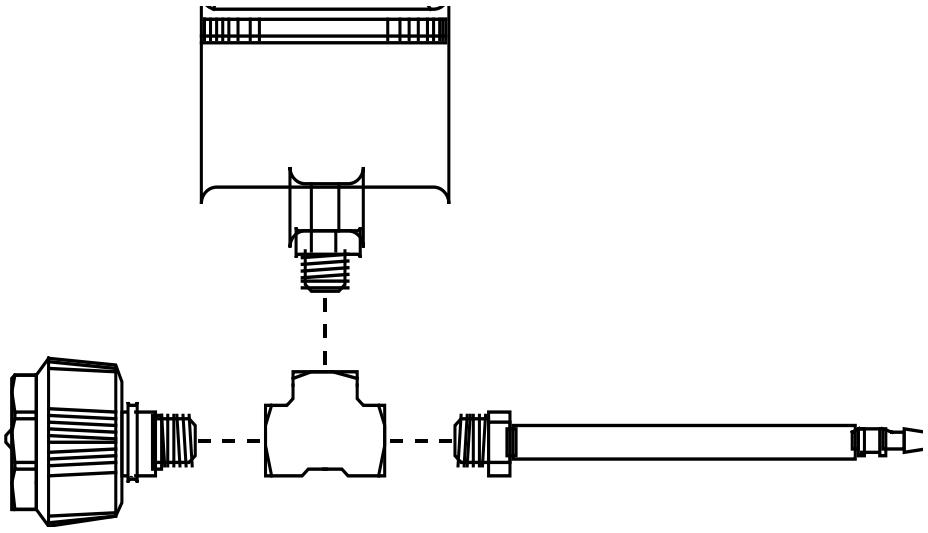


Figure A-1
Air/O_2 500 cc/min test tool

B. Temperature Conversion Chart

°C	°F	°C	°F	°C	°F
20.0	68.0	34.5	94.1	37.6	99.7
21.5	70.7	35.0	95.0	37.7	99.9
22.0	71.6	35.1	95.2	37.8	100.0
22.5	72.5	35.2	95.4	37.9	100.2
23.0	73.4	35.3	95.4	38.0	100.4
23.5	74.3	35.4	95.7	38.1	100.6
24.0	75.2	35.5	95.9	38.2	100.8
24.5	76.1	35.6	96.1	38.3	100.9
25.0	77.0	35.7	96.3	38.4	101.1
25.5	77.9	35.8	96.4	38.5	101.3
26.0	78.8	35.9	96.6	38.6	101.5
26.5	79.7	36.0	96.8	38.7	101.7
27.0	80.6	36.1	97.0	38.8	101.8
27.5	81.5	36.2	97.2	38.9	102.0
28.0	82.4	36.3	97.3	39.0	102.2
28.5	83.3	36.4	97.5	39.5	103.1
29.0	84.2	36.5	97.7	40.0	104.0
29.5	85.1	36.6	97.9	40.5	104.9
30.0	86.0	36.7	98.1	41.0	105.8
30.5	86.9	36.8	98.2	41.5	106.7
31.0	87.8	36.9	98.4	42.0	107.6
31.5	88.7	37.0	98.6	42.5	108.5
32.0	89.6	37.1	98.8	43.0	109.4
32.5	90.5	37.2	99.0	43.5	110.3
33.0	91.4	37.3	99.1	44.0	111.2
33.5	92.3	37.4	99.3	44.5	112.1
34.0	93.2	37.5	99.5	45.0	113.0

C. Patient Probe Characteristics

Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms
29.9	8071.2	34.0	6778.2	38.1	5716.0	42.2	4839.5
30.0	8036.5	34.1	6749.8	38.2	5692.5	42.3	4820.1
30.1	8002.0	34.2	6721.5	38.3	5669.2	42.4	4800.8
30.2	7967.6	34.3	6693.3	38.4	5646.0	42.5	4781.6
30.3	7933.4	34.4	6665.3	38.5	5622.9	42.6	4762.5
30.4	7899.4	34.5	6637.3	38.6	5599.9	42.7	4743.5
30.5	7865.6	34.6	6609.6	38.7	5577.0	42.8	4724.5
30.6	7831.9	34.7	6581.9	38.8	5554.3	42.9	4705.7
30.7	7798.3	34.8	6554.4	38.9	5531.6	43.0	4686.9
30.8	7765.0	34.9	6527.0	39.0	5509.0	43.1	4668.3
30.9	7731.7	35.0	6499.8	39.1	5486.6	43.2	4649.7
31.0	7698.7	35.1	6472.6	39.2	5464.2	43.3	4631.2
31.1	7665.8	35.2	6445.7	39.3	5441.9	43.4	4612.7
31.2	7633.1	35.3	6418.8	39.4	5419.8	43.5	4594.4
31.3	7600.5	35.4	6392.1	39.5	5397.7	43.6	4576.1
31.4	7568.1	35.5	6365.4	39.6	5375.8	43.7	4558.0
31.5	7535.9	35.6	6339.0	39.7	5354.0	43.8	4539.9
31.6	7503.8	35.7	6312.6	39.8	5332.2	43.9	4521.9
31.7	7471.8	35.8	6286.4	39.9	5310.6	44.0	4503.9
31.8	7440.0	35.9	6260.3	40.0	5289.0	44.1	4486.1
31.9	7408.4	36.0	6234.3	40.1	5267.6	44.2	4468.3
32.0	7376.9	36.1	6208.4	40.2	5246.2	44.3	4450.6
32.1	7345.6	32.2	6182.7	40.3	5225.0	44.4	4433.0
32.2	7314.4	36.3	6157.0	40.4	5203.9	44.5	4415.5
32.3	7283.4	36.4	6131.5	40.5	5182.8	44.6	4398.1
32.4	7252.5	36.5	6106.2	40.6	5161.9	44.7	4380.7
32.5	7221.8	36.6	6080.9	40.7	5141.0	44.8	4363.4
32.6	7191.2	36.7	6055.8	40.8	5120.2	44.9	4346.2
32.7	7160.8	36.8	6030.7	40.9	5099.6	45.0	4329.1
32.8	7130.5	36.9	6005.8	41.0	5079.0		
32.9	7100.4	37.0	5981.1	41.1	5058.5		
33.0	7070.4	37.1	5956.4	41.2	5038.2		
33.1	7040.5	37.2	5931.8	41.3	5017.9		
33.2	7010.8	37.3	5907.4	41.4	4997.7		
33.3	6981.3	37.4	5883.1	41.5	4977.6		
33.4	6951.8	37.5	5858.9	41.6	4957.6		
33.5	6922.6	37.6	5834.8	41.7	4937.7		
33.6	6893.4	37.7	5810.8	41.8	4917.9		
33.7	6864.4	37.8	5786.9	41.9	4898.1		
33.8	6835.5	37.9	5763.1	42.0	4878.5		
33.9	6806.8	38.0	5739.5	42.1	4858.9		

D. Servo Mode Algorithm

The servo mode uses the difference between the servo mode control temperature and the patient skin temperature to determine the percent of heater power required:

Control Temp – Patient Temp			Percent Heater Power
ž 0.45°C			100
0.44	to	0.30°C	95
0.29	to	0.25°C	90
0.24	to	0.20°C	85
0.19	to	0.15°C	75
0.14	to	0.10°C	65
0.09	to	0.05°C	45
0.04	to	–0.04°C	25
–0.05	to	–0.09°C	20
–0.10	to	–0.14°C	15
–0.15	to	–0.19°C	10
–0.20	to	–0.24°C	5
–0.25°C			0

A.2 Infant Warmer System Specifications

A. Electrical specifications

Power requirements

Units with HCA or HCC serial numbers
120 V, 50/60 Hz Model: 115 V~ ± 10%, 6.6 Amps.- maximum
220 V, 50/60 Hz Model: 220V~ ± 10%, 3.7 Amps.- maximum
230 V, 50/60 Hz Model: 230V~ ± 10%, - 6%, 3.4 Amps.- maximum
240 V, 50/60 Hz Model: 240 V~ ± 10%, 3.3 Amps.- maximum
100 V, 50/60 Hz Model: 95 V~ ± 10%, 8.2 Amps.- maximum

Units with AAN, HAJ or HAK serial numbers
120 V, 50/60 Hz Model: 115 V~ ± 10%, 5.7 Amps.- maximum
220 V, 50/60 Hz Model: 220V~ ± 10%, 3.0 Amps.- maximum
240 V, 50/60 Hz Model: 240 V~ ± 10%, 2.7 Amps.- maximum
100 V, 50/60 Hz Model: 95 V~ ± 10%, 6.4 Amps.- maximum

All models designed to conform to IEC 601-1, UL544, CSA 22.5, SEMKO and TUV requirements.

Line voltage compensation

Input line voltage is monitored and the heater drive is adjusted to compensate for variations in the line voltage. This ensures a stable heater output despite input line voltage fluctuations.

Circuit breaker

Rated Current: 7.5 Amps.
Trip Point: 9.45 Amp Minimum.
Type: Manual Resetting.
Model: Airpax Snapak.

Isolation voltage

2500 Vrms 60 Hz from the patient probe to the ac phase and neutral lines for one minute.

WARNING

⚠ The patient probe is not isolated from earth ground. Any additional equipment used with the Ohmeda Infant Warmer System must comply with UL 544, CSA 22.2, IEC 601, and VDE 750.

Leakage current

UL544: When measured at an exposed metal surface with the ground wire open, the leakage current should be less than 300 micro amperes on 100V and 120V, 50/60 Hz units

CSA 22.2 M125: When measured at an exposed metal surface with the ground wire open, the leakage current should be less than 100 micro amperes on 100V and 120V, 50/60 Hz units

IEC 601-1: When measured at an exposed metal surface with the ground wire open, the leakage current should be less than 500 micro amperes on 220V, 230V and 240V, 50/60 Hz units

Ground resistance

0.1 ohms or less. Less than 0.2 ohms when measured from the power cord ground pin to an exposed metal surface.

B. IEC 601-1 Specifications

Type of protection against electric shock:	Class 1
Degree of protection against electric shock:	Type B
Mode of Operation:	Continuous
Protection against hazards of explosion:	Not Protected
Protection against ingress of liquids:	Not Protected

C. Performance Specifications

Controller electronics

Microprocessor-based control system. Self-test functions are performed at power up and during normal operation.

Power control method

Proportional heat control with zero-voltage switching to minimize radiated and conducted EMI.

Observation light

Nominal illuminance output: 100 foot candles at center of mattress.

Estimated lamp life: 3,000 hours.

Patient temperature measurement range

Range displayed: +22 to 42°C

Accuracy: ±3°C within a range of 30-42°C

Resolution: ±0.1°C

Probe interchangeability: ±0.1°C

Probe Model Number: LA003 or LA005

Elapsed timer

60 minute elapsed timer with hold mode and Apgar tones.

Manual mode heat selector range

All HCA and HCC units and Model 5000: 0 to 540 watts in 20 increments of 5% each.

Models without HCA or HCC serial numbers: 0 to 440 in 20 increments of 5% each.

Servo mode control range

35.0 to 37.5°C in increments of 0.1°C (all models except the 2001 international)

Alarms

Multiple audio tones:	Operator prompt tone.
	Alternating single tone.
	Alternating two tone.

Overhead Alarm Light

Large alarm light located on the front of the heater assembly for easy visual identification.

Probe Failure Alarm

The alternating two tone alarm is active only in the servo mode. Activates when the skin temperature probe:

1. Fails electrically due to an open or short circuit, or
2. Is disconnected from the Warmer.
3. Probe senses temperature outside the 01 - 50° C range.

When this alarm condition exists:

1. The heater is turned off and
2. The patient temperature display flashes “HH.H” or “LL.L”.

Note: Temperature is only displayed in the 22.0 - 41.9° C range inclusive. In both the servo and manual modes, temperatures below 22.0° C display “LL.L”, and temperature above 41.9° C display “HH.H”. Temperatures above 50° C cause a blank display in the manual mode. Temperatures below 01° C display “HH.H” in the servo mode.

Patient Temperature Alarm

This single tone alarm activates in the servo mode when the difference between the patient temperature and the control temperature is greater than 1°C (can be adjusted to 0.5°C by qualified service person). Alarm cancels when the patient temperature returns to within 0.8°C of the control temperature.

System Failure Alarm

This alternating, two tone alarm cannot be silenced. Alarm activates and turns the heater off if any of the following occurs:

1. The analog-to-digital converter calibration drifts by more than 0.3°C.

2. The heater solid state relay fails.

3. The microprocessor fails -

4. The self check functions fail on power-up.

Note: Excessive EMI in the hospital environment can trigger the system failure alarm. Note the error code, if any, and switch off the unit. Wait ten seconds and switch the power back on. If the system fail alarm recurs, remove the warmer from use.

Check Patient Alarm

Manual Mode: Single tone alarm activates if the heater has been energized at greater than 25% heat for 12 continuous minutes.

Servo mode: Alarm activates when the heater has been at full power for 12 continuous minutes. Alternating two tone alarm activates after 3 minutes if the Check Patient Alarm is not silenced.

Power Failure Alarm

Single tone alarm activates if the line power is interrupted. On unit with HCC serial numbers, the Power Failure LED illuminates. A rechargeable maintenance-free nickel cadmium battery powers the audio alarm and the microprocessor for up to 10 minutes with a fully charged battery. If power is restored within 10 minutes, the mode of operation and the set point are recalled.

Heat Off Alarm

The Light-Emitting-Diode (LED) indicator activates when the heater is in the side position. The audio alarm activates after the heater has been in the side position for 5 minutes.

D. Environmental

Temperature range

Operating Temperature range: 10 to 40°C (50 to 104° F)

Transport and Storage Temperature range: -25 to 60°C (-13 to 140° F)

Operating and Storage Pressure range: 500 to 1060 hPa

Operating and Storage Relative Humidity range: 0 to 95%.

E. Electromagnetic Compatibility (EMC) Specifications

All models meet the requirements as specified in IEC 601-1-2
Collateral Standard Electromagnetic Compatibility - Requirements and Tests.

F. Mechanical Specifications

Overall dimensions without accessories

Model number	Height in./cm	Depth in./cm	Width in./cm	Max.Wt** lbs/kg
2001	73/185	41/104	26/66	210/96
3000	73/185	45/114	26/66	165/75
3050	11/28*	33/84	18/46	40/18
3100	60/152*	33/84	21.5/55	75/34
3150	60/152*	36/91	21.5/55	110/50
3300	73/185	41/104	26/66	210/96
3400	72-80/183-203	45/114	30.5/77	200/91
3500†	73/185	40.5/103	24.5/62	228/102
4000	73/185	52/132	30.5/77	175/80
4300	73/185	45/114	30.5/77	222/101
4400	72-80/183-203	45/114	30.5/77	200/91
5000	72-80/183-203	45/114	32/81	210/96

* Height of equipment itself, height from floor will vary on application.

† Includes bassinet.

**Units without drawers: for units with stationary drawers add 56 lbs (25 kg), for units with rotating drawers add 70 lbs (32 kg).

Mattress dimensions

Model number	Width in./cm	Length in./cm
2001	18.2/46	25.2/64
3000	—	—
3050	—	—
3100	—	—
3150	18.2/46	25.2/64
3300	18.2/46	25.2/64
3400	18.2/47	25.2/64
3500	18.2/46	25.2/64
4000	—	—
4300	23.2/59	29.2/74
4400	23.2/59	29.2/74
5000	23.2/59	29.2/74

Casters

Model number	
2001	5" (13cm) dia., 2 locking, 2 non locking
3000	5" (13cm) dia., 2 locking, 2 non locking
3050	—
3100	—
3150	—
3300	5" (13cm) dia., 2 locking, 2 non locking
3400	5" (13 cm) dia., 2 locking, 2 non locking
3500	Warmer- 2" dia., 2 (5cm)locking, 4 non locking Bassinet -5" (13cm) dia., 2 locking, 2 non locking
4000	5" (13cm) dia., 2 locking, 2 non locking
4300	5" (13cm) dia., 2 locking, 2 non locking
4400	5" (13cm) dia., 2 locking, 2 non locking
5000	5" (13cm) dia., 2 locking, 2 non locking

Drawers†

Model number	
2001	3 drawers- 15" x 15.5" x 4" (39 x 39 x 10 cm) or 1 drawer 15" x 15.5" x 4" (39 x 39 x 10 cm), 1 drawer 15" x 15.5" x 9" (39 x 39 x 23 cm)
3000	—
3050	—
3100	—
3150	3 drawers- 15" x 15.5" x 4" (38 x 39 x 10 cm) or 1 drawer 15" x 15.5" x 4" (38 x 39 x 10 cm), 1 drawer 15" x 15.5" x 9" (38 x 39 x 23 cm)
3300	3 drawers- 15" x 15.5" x 4" (38 x 39 x 10 cm) or 1 drawer 15" x 15.5" x 4" (38 x 39 x 10 cm), 1 drawer 15" x 15.5" x 9" (38 x 39 x 23 cm)
3400	3 drawers- 15" x 15.5" x 4" (38 x 39 x 10 cm) or 1 drawer 15" x 15.5" x 4" (38 x 39 x 10 cm), 1 drawer 15" x 15.5" x 9" (38 x 39 x 23 cm)
3500	1 drawer- 12" x 15" x 3" (30 x 39 x 8 cm) 2 drawers - 12" x 15" x 3" (39 x 39 x 15 cm
4000	—
4300	3 drawers- 15" x 15.5" x 4" (38 x 39 x 10 cm) or 1 drawer 15" x 15.5" x 4" (38 x 39 x 10 cm), 1 drawer 15" x 15.5" x 9" (38 x 39 x 23 cm)
4400	3 drawers- 15" x 15.5" x 4" (38 x 39 x 10 cm) or 1 drawer 15" x 15.5" x 4" (38 x 39 x 10 cm), 1 drawer 15" x 15.5" x 9" (38 x 39 x 23 cm)

†Dimensions for both the stationary and rotating drawer packages are the same.

Bed tilt positions

3500: ± 8° in increments of 4°

All other models: ± 10° continuously adjustable

Bed duty cycle (Elevating models only)

Type 1
20 seconds on
15 minutes off
Type 2
1 minute on
10 minutes off

3500 Bassinet

Bed height: 40.5 in (103 cm)
Material: Select oak and oak veneer. Optional custom stain colors are available.
Storage: Three Drawer storage opening from either side or the front of the unit, depending on the model ordered.

Accessories

Air/Oxygen Yoke and Regulator
Pin indexed oxygen yokes accommodate two E size oxygen cylinders.
Additional yoke accommodates one E-size cylinder of compressed air.
Air and oxygen pipeline fittings.
Regulators: 52 ± 2 psig (at cylinder pressure of 1500 psig)
(358 ± 14 kPa) (4 bar ± 138 millibar in the U.K.).
Cylinder pressure gauges: 0 to 3000 psig (0 to 20700 kPa)

Oxygen Yoke and Regulator
Pin indexed yokes accommodate two E size oxygen cylinders.
Oxygen pipeline fittings.
Regulator: 52 ± 2 psig (at cylinder pressure of 1500 psig)
(358 ± 14 kPa) (4 bar ± 138 millibar in the U.K.).
Cylinder pressure gauge: 0 to 3000 psig (0 to 20700 kPa)

Rail Mounted Accessories

WARNINGS

⚠ Overloading the shelves can affect the stability of the unit. Limit the load to 20 lbs. (9 kg) per instrument shelf, mounted to a single upright, and 50 lbs. (23 kg) per monitor shelf, mounted between the uprights.

⚠ Limit the load of accessories to 50 pounds (23 kg) per side on the Warmer to ensure stability. Accessories should not be mounted more than 56 inches (142 cm) above the floor. For models 3000 and 3500, limit the load of accessories to 20 pounds (9 kg) per side mounted no more than 44 inches (112 cm) above the floor.

⚠ Due to the increased height of units with the ECMO option installed, a tipping hazard may exist. Limit the total accessory load to 50 lbs. (23 kg), no more than 25 lbs. (11 kg) per side.

System 2001/3000/3300/4000 Monitor Shelf
Dimensions 12 x 26 inches (30 x 66 cm)
Load limit: 50 lbs (22 kg)

System 5000 Monitor Shelf
Dimensions 12 x 30.5 inches (30 x 77 cm)
Load Limit: 50 lbs (22 kg)

Instrument shelf
Dimensions 12 x 12 inches (30 x 30 cm)
Load limit: 20 lbs (9kg)
Oxygen flowmeter with DISS fittings: 0 to 15 LPM
Air flowmeter with DISS fittings: 0 to 15 LPM
Airway Manometer: -20 to +100 centimeters of water

IV pole

Gas manifold with 1/8 inch NPT fitting

3.5 inch utility post

Utility Post, 22 Inch (0217-5376-800) 1 inch diameter x 22 inch long post

Provides a rigid vertical mounting space for stack mounting of equipment. The post should be mounted as low as possible to ensure the stability of the Warmer.

Vacuum Manifold with DISS Adapters

Two DISS vacuum adapters are mounted on a standard manifold block. The locations of these adapters can be changed to any of the other tapped holes in the block to meet special requirements.

Vacuum Bottle Slide Bracket

The standard vacuum bottle slide can be mounted on either upright.

Ventilator Mounting Post

The vertical mounting post is a non-locking 1 inch diameter shaft which pivots in an 8.5 inch radius from the upright. One end of the shaft extends 14 inches while the other extends 6.5 inches. Ventilators, humidifiers, blenders or other user hardware can be pivoted into optional position.

G. Heater Specifications

Heater Output

All models with HCA and HCC serial numbers:
540 watts ± 5% at maximum % power setting.
Average Energy at Mattress Level at maximum % power setting:
34 mW/cm^2 for Model 2001 and Series 3000 with HCA and HCC serial number
20 mW/cm^2 for Model 5000 with AAN serial number
22 mW/cm^2 for Model 2001 and Series 3000 with HAK and AAN serial number

Recommended Bed Level

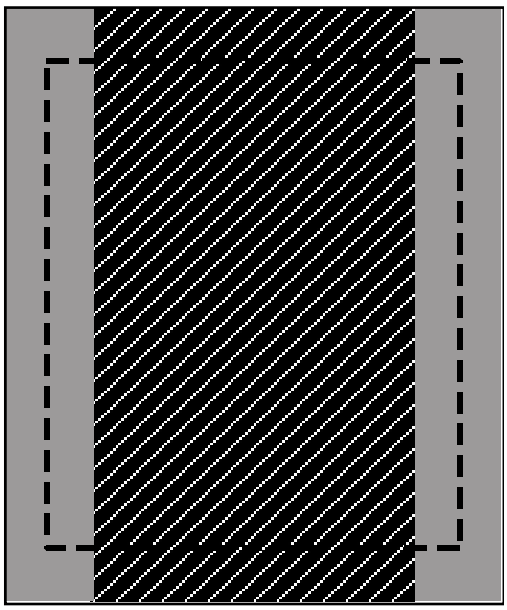
27 ± 2 inches (69 ± 5cm) from bottom of heater grill.

WARNING ⚠ Bed-to-heater spacing less than the recommended 25 inches will result in incorrect operation and may adversly affect the patient's condition.

Radiant Energy Distribution

This table lists typical average radiant energy distribution across the patient bed surface for informational purposes only.

Typical Radiant Energy Level
on the Mattress Surface



Infant Zone ,15" (38cm) wide

Mattress- Model 2001/Series 3000

Mattress- Model 5000/Series 4000

	mW/cm^2	
	Zone Average	Mattress Average
Model 2001 and Series 3000 units†	34	34
Model 5000 and Series 4000 units	22	20

† The radiant energy values of older models will be 24 zone average and 22 mattress average: units prior to those with HCA and HCC serial numbers had a 440 Watt heater.

A.3 ThermaLink Option Specifications

A. Hewlett Packard CMS Monitor (Vuelink)

The warmer may be connected to a Hewlett Packard CMS Monitor via a Vuelink open interface module (HP P/N M1032A Option A05) and Ohmeda option cable . The parameters passed to the HP monitor are: patient temperature, set temperature, and heater power level; these three parameters are displayed by default on power-up. The user can select to display any or all of these parameters. All alarms are also passed to the monitor. See the Hewlett Packard CMS and Vuelink manuals for features and functions of the HP system.

B. SpaceLabs Monitor (Flexport)

The warmer may be connected to a SpaceLabs Bedside Monitor via a Flexport (SL P/N 90444A). The parameters passed to the SpaceLabs Bedside Monitor are: patient temperature, set temperature, and heater power level. All alarms are also passed to the monitor. See the SpaceLabs Monitor and Flexport manuals for features and functions of the SL system

C. Serial data

WARNING

⚠ The computer or RS-232 monitor's user program must continuously check the data link. The program should constantly verify connection to the warmer controller and check for updated data.

Note: In the event of power failure, all serial communication will cease until power is restored.

RS-232 Connector

The Nurse Call and the serial data output share the same female, nine pin, d-type connector (DB9F).

Pin 2: Receive Data (warmer input)

Pin 3: Transmit Data (warmer output)

Pin 5: Gnd (Signal Ground)

Cable requirements

The user interface cable must have capacitance less than 1500 pF. It should be a shielded cable such as a Belden 9611 with AMP shielding kit 748046-1 and ferrule 747579-8.

Data transmission

The warmer continuously sends data from the time that it is first powered up. Note that the warmer serial data transmission can be controlled through the serial port. Data output stops when the warmer receives a <cntrl>S (XOFF) and resumes when it receives a <cntrl>Q (XON).

Data format

1 start bit, 7 data bits (ASCII), 1 parity bit (odd), 1 stop bit, 1200 baud, full duplex.

Serial data has the format: start text character, "<stx>"; IWS header, "IW"; software version; data string; checksum characters; carriage return, "<cr>"; line feed, "<lf>"; end of text character, "<etx>". Data elements are separated by spaces, "_". Each String contains 53 characters:

Sample data:

<stx>IW0500_35.52_XX.XX_P_00085_36.50_00001000_E014_11<cr><lf><etx>

Data for discussion (use the following table):

<stx>IWxxxx_pt.pt_xx.xx_m_ppppp_pc.pc_alrmleds_code_ck<cr><lf><etx>

<stx>

Start of text character (ASCII 2) or CTRL B; indicates a string of data will follow.

IWxxxx

IW means the data is from the Infant Warmer; xxxx is the software version in the unit, e.g. 0500 for version 5.00.

pt.pt

This is the patient temperature in degrees centigrade. The patient temperature will always be sent even if it is outside the normal display range. Temperatures less than or equal to 1.00°C indicate an open or a disconnected probe. Any temperature greater than or equal to 50°C is a shorted probe.

xx.xx

Reserved for future use.

m

This is the mode of operation. P means servo control mode. A means manual control mode. Always check the mode of operation before evaluating the patient control temperatures.

ppppp

Percentage of nominal power defined as % of heater wattage.

pc.pc

In the servo control mode, this is the patient control temperature set with the ▲ and ▼ switches in degrees centigrade.

alrmleds

This series of bits represents the alarm LEDs. If an LED is illuminated, the corresponding bit is set to 1 (alarm active). If there is no alarm, the bit is set to 0. Audible alarm status bit is 1 if an alarm condition exists and if the alarm is not silenced. Audible alarm status bit is 0 if there are no active alarms, or if the active alarms are silenced.

00000100

\ \ \ \ \ \ \ _____ Probe Failure Alarm

\ \ \ \ \ \ _____ Patient Temperature Alarm

\ \ \ \ \ _____ System Failure Alarm

\ \ \ \ _____ Heat Off Alarm

\ \ \ _____ Check Patient Alarm

\ \ _____ Reserved

\ _____ Power Failure Alarm

_____ Audible Alarm Status Bit

code

This is the error code that appears in the control temperature display during a system failure alarm (e.g. E014). If the system is operating normally (no system failure), zeroes replace the error code (e.g. E000).

ck

This is the two byte ASCII representation of the byte that when added to the sum of all the ASCII data bytes in the string equals zero. Note that all over flows are dropped and the sum of the data bytes DOES NOT INCLUDE the <stx>, checksum, <etx>, <cr>, or <lf> characters or the parity bit of each byte.

<cr>

Carriage return character.

<lf>

Line feed character.

<etx>

End of transmission character (ASCII 3) or CTRL B.

D. Nurse Call specifications

Contact ratings

Maximum resistive load: 4 VA
Maximum DC switching voltage: 100 Vdc
Maximum switching current: 0.25 A
Maximum carrying current: 0.50 A.

Connector

The Nurse Call contacts and the serial data output share the same female, nine pin, d-type connector (DB9F).

Pin 6: Closed contact under normal conditions, i.e. power on, no alarm (recommended configuration)

Pin 1: Common contact

Pin 9: Open contact under normal conditions, power on, no alarm

These contacts are not powered. They only provide closure.

Table A-1
Nurse Call signals

Warmer Status	Nurse Call Signal Pins 1&6	Pins 1&9
Normal	Closed	Open
Alarm	Open	Closed
Power switch off or power fails	Open	Closed
Nurse Call cable disconnected	Open	Open

WARNING ⚠ If you use the normally open Nurse call connection, a disconnected Nurse Call cable DOES NOT trigger a remote alarm.

Note: Any interruption of warmer power (deliberately switching off the warmer , accidentally unplugging the power cord, etc.) triggers a Nurse Call alarm.

A.4 Accessory Service Procedures

A. Disassembling and servicing rotating drawer package

(see Figure 7-26 for part numbers)

WARNING ⚠ On Model 3300 and 4400 warmers factory equipped with drawers, if the drawers are removed and not re-installed, a leg weight must be installed in the right leg of the unit to ensure the stability before the warmer can be placed in service.

1. Remove the drawers from the cabinet by extending the drawer slides and unlatching them from the drawers. Return the slides to the closed position.

2. Place a two by four or some other suitable support across the warmer base legs under the drawer package to sustain the weight of the drawer assembly (approximately 70 lbs).

3. Access to the drawer cabinet mounting screws is different depending on which model you are servicing:

   A. On large bed units (series 4000 & 5000), rotate the drawers to the front of the warmer to locate the screws that secure the cabinet to the bed support casting. Two screws are located inside the drawer cabinet, accessible through 3/4" dia. holes in the cabinet top. Two are located in back of the cabinet.

B. On standard bed units (series 3000 & 2001), rotate the drawers to the right side of the warmer to remove the screws that secure the cabinet to the bed support casting. All four screws are located inside the cabinet, accessible through 3/4" dia. holes in the cabinet top.

4. Remove the Phillips head screws (located in step 3) that mount the drawer assembly to the warmer. Move the drawer assembly clear of the warmer.

5. On large bed units you must remove two additional mounting screws. To access the mounting screws, turn the drawer cabinet over, so that the top sits flat on the floor. Rotate the cabinet 90° counterclockwise. Remove the mounting screws.

6. Remove the drawer shelf from the top plate.

7. Inspect the operation of the detents and bearings by rotating the upper plate.

8. To disassemble the upper plate remove the cotter pin, slotted nut and 1/2-13 carriage bolt.

9. Inspect the large plastic bearing, internal cam in the rotation cover, and the function of the sliding cam follower. Replace any worn or broken parts.

10. Lubricate the large plastic bearing and sliding cam follower with Lubriplate (0220-5150-300).

11. Re-install the upper plate with the cotter pin, slotted nut and 1/2-13 carriage bolt removed earlier. After tightening the slotted nut to remove all slack, tighten it an additional 3/4 turn and install the cotter pin.

12. Complete re-assembly by reversing steps 1 through 7.

B. Installing the X-ray tray

(See Section 7 for part numbers)

Installing Slides

1. Insert a slide (long side down) into the large slot under the bed, then push the slide, threaded studs first, against the forward edge of the bed cavity. The studs should then straddle the diagonal ribs under the bed.

2. Slip a shoulder washer over each of the two threaded studs, (see detail) then screw on the threaded knobs, clamping the slide to the diagonal rib.

3. Repeat above steps for installation of the second slide in the rear.

4. Slip the X-ray tray into the slides under the bed.

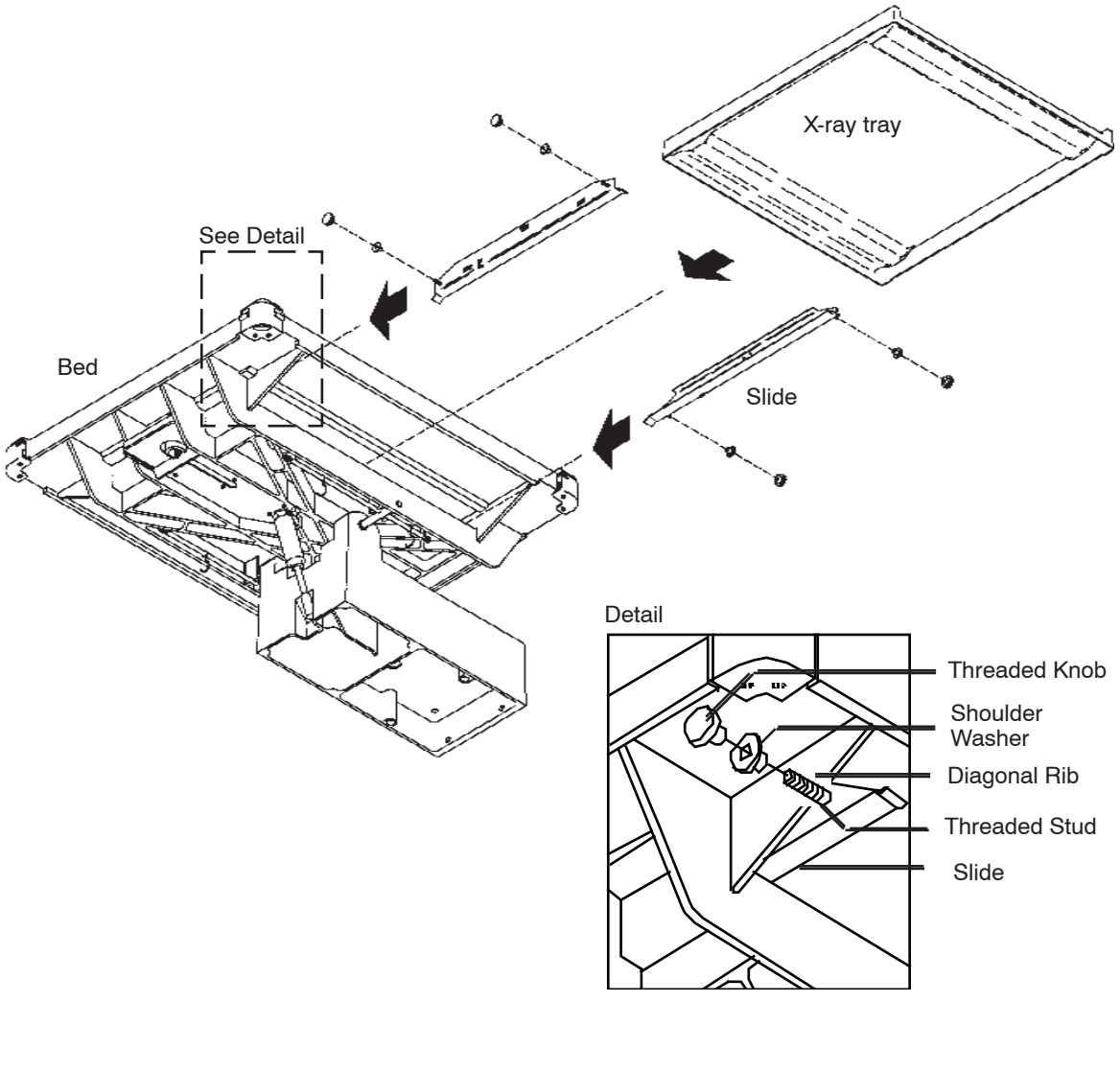


Figure A-1
Tray installation

Installing Side Panel Decals

1. Before installing the decals, remove the bed side panels and thoroughly clean according to the cleaning recommendations in section 4 of the Infant Warmer System Operation and Maintenance manual.

   Note: Be sure to apply Short Decals only to Short Panels, and Long Decals only to Long Panels.

2. The decals are sandwiched between a Backer and a Front Liner (see Figure A-6). Peel the first long decal, using the Front Liner, away from the Backer, being careful not to allow decal to fold onto itself.

   Note: leave the decal adhered to the back of the Front Liner at this time.

3. Place the first long side panel so that the side WITHOUT an edge bevel on the acrylic faces you (so the decal mounts on the non-beveled side, see Figure A-6). Align left edge and bottom of decal front liner with left edge and bottom of acrylic panel. Keep bottom straight while pressing down remainder of decal working from left to right to remove all air bubbles.

4. With the front liner still applied, rub entire decal down firmly with a smooth tool to ensure good adhesion.

5. SLOWLY Peel off front liner and discard. Repeat steps for remaining three panels. Replace panels onto warmer bed.

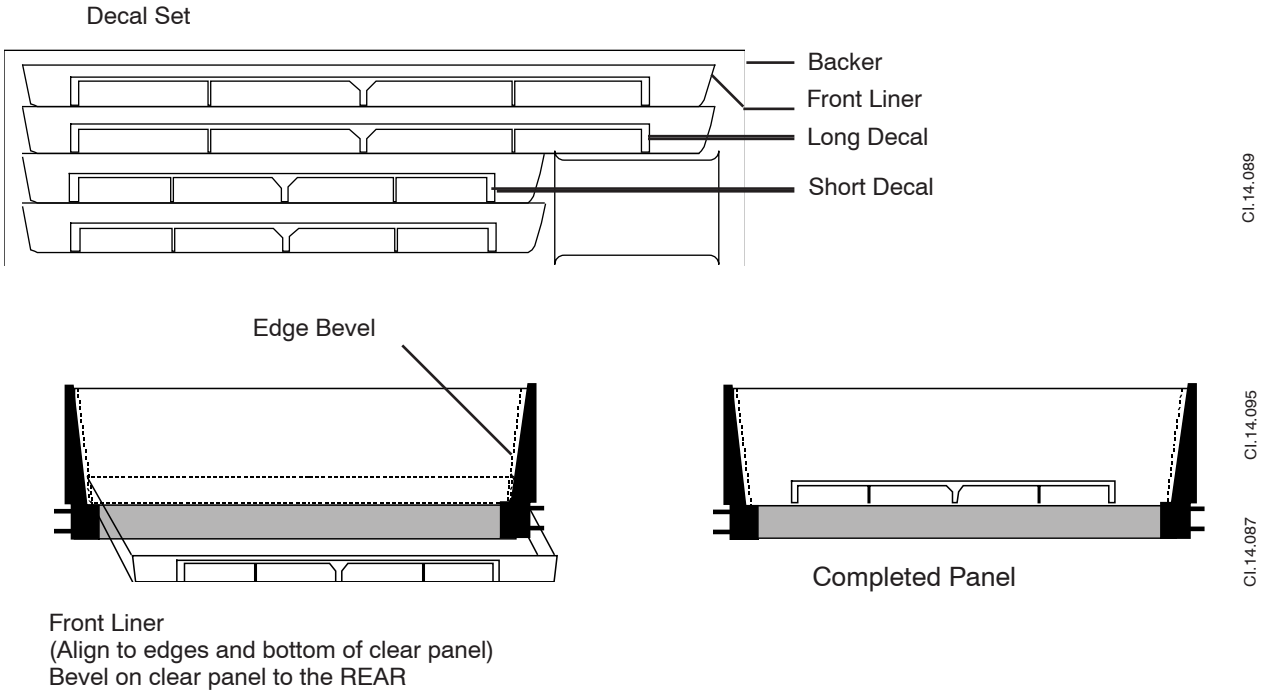
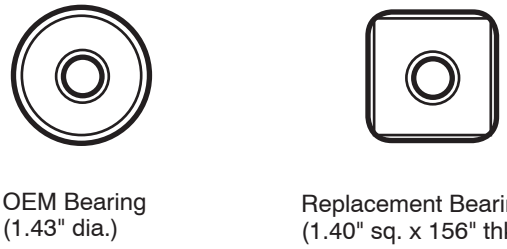


Figure A-2
Bed panel decals

C. Bearing replacment on Type 1 Elevating Units



OEM Bearing
(1.43" dia.)

Replacement Bearing
(1.40" sq. x 156" thk.)

Figure A-3
Bearings

Note: The replacement bearings in kit (6600-0069-850) are not interchangeable with the square bearings in newer Type 2 elevating units.

Typical symptoms indicating a need for service to the column bearings include:

- The column moves with quick, abrupt motions rather than smooth even travel.
- The column moves with vibration.
- There is excessive column tilting.

Raise the elevating column to the maximum height. Follow the instructions in section 5 for removing the bed and heater assembly from the IWS.

(See Figure A-4)

1. Remove the upper bolt which attaches the flange to the top of the actuator.

   Note: There is an external tooth lock washer between the head of the bolt and the upper flange. There is also another lock washer, on the same bolt, under the flange between the top of the actuator and the flange.

2. Remove the connector and strain relief from the coiled power cord.

   To release the pins push a small screw driver down either side of the pins to push in the pin tabs (or use pin extraction tool, AMP PN 458994-2), then grasp the wire and pull the pins out of the other end of the connector.

   To re-assemble the connector the pin numbers are marked on the back of the plastic connector:

   1= white 3 = black

   2 = red 4 = green

   To release the strain relief squeeze it with pliers and pull it up out of the flange ground wire.

3. Pull the inner column to separate it from the assembly. If the column proves too difficult to remove by pulling, use the spring spreaders (6600-0650-400) to release the bearing pressure. Insert a spreader between each of the four sets of blocks and springs located inside the column.

3. Remove the inner column.

4. Remove the spring spreaders.

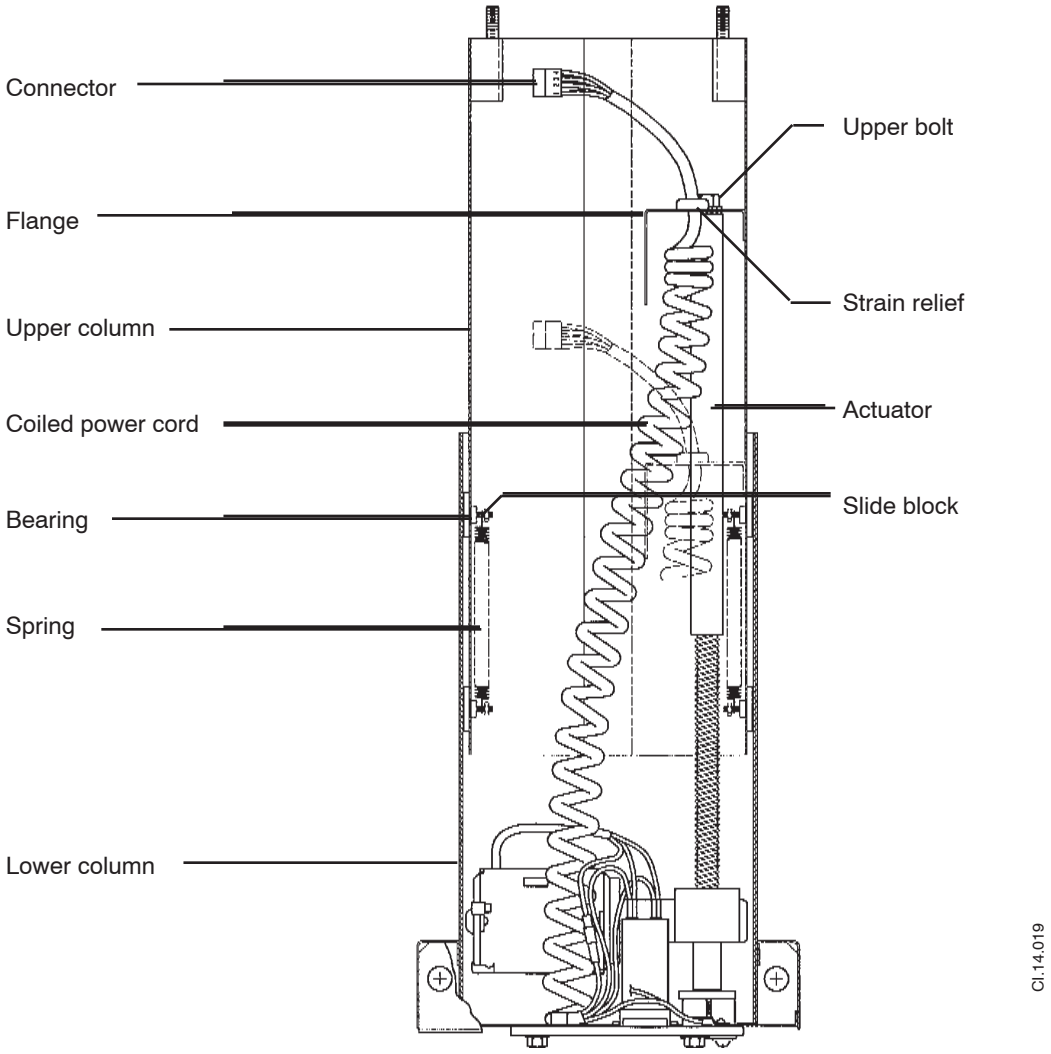


Figure A-4
Column Cut-away Type 1 unit

5. Wipe away any old grease from the channels.

6. Use a 3/8" nut driver to remove the nuts holding the springs onto the screws.

7. Remove the springs.

8. Remove the bearing assembly screws. It will be necessary to heat the slide blocks with the heat gun or torch to soften the thread locking agent. Try to turn the screw periodically while heating it to determine when the thread locking agent has been sufficiently softened. The screw will turn easily once sufficient heat has been applied. Be careful not to shear the screw by applying too much torque.

9. Repeat the procedure for all eight bearing assemblies.

10. Discard the old bearings.

11. Re-install the bearing assemblies using the square replacement bearings.

12. Apply a drop of #242 Loctite (0220-5017-300) about .25 inches down from the head of the screw before installing.

13. Re-connect the springs.

14. Apply a drop of #242 Loctite to the end of the screw and install the spring retaining nut.

15. Apply lubriplate grease (6600-0095-300) liberally to the plastic bearings, slide block, angled slots and channels.

16. Install the spring spreaders between each of the four bearing pairs.

17. Insert the inner column into the assembly.

18. Install the bolt to attach the flange to the upper end of the actuator.

    Note: Make sure you re-install both the lock washer between the head of the bolt and the top of the flange, and the one under the flange between the top of the actuator and the flange.

19. Remove the spreaders.

20. Re- connect coiled power cord.

21. Perform electrical safety section 4 and checkout procedures in section 2.

Appendix

A.5 Installing wall mounted units

WARNING ⚠ **Carefully follow these installation instructions. Failure to do so may result in serious injury to the operator or patient.**

The model 3050, 3100, and 3150 wall mounted warmers were designed for locations where permanent, infant radiant warmers attached directly to the room wall are desired. To adequately install these models, pre-planning at the architectural design phase is required.

The following instructions describe the manufacturer's recommended method of installation in new construction. Use only the Ohmeda hardware provided to mount the model 3050, 3100, and 3150. The installation should be approved by the appropriate State and Local authorities. Deviation from these recommendations or attempts to retrofit existing construction should only be undertaken by professionals experienced in structural design, who in turn are wholly responsible for the structural integrity of the mounting method they devise.

Pre-Installation Preparation

A pattern of two (2) Extra Duty Drywall Studs (STE-20 gage) and one (1) 4" x 1-1/2" (10 x 4 cm) Drywall Track (16 gage) at 16 inch (41 cm) centers form the basic "rough in" for installing each IWS 3050 unit. See Figure A-5. Verify that the studs and track are securely fastened together at 12 inch intervals and to both the floor and ceiling tracks with #10 sheet metal screws.

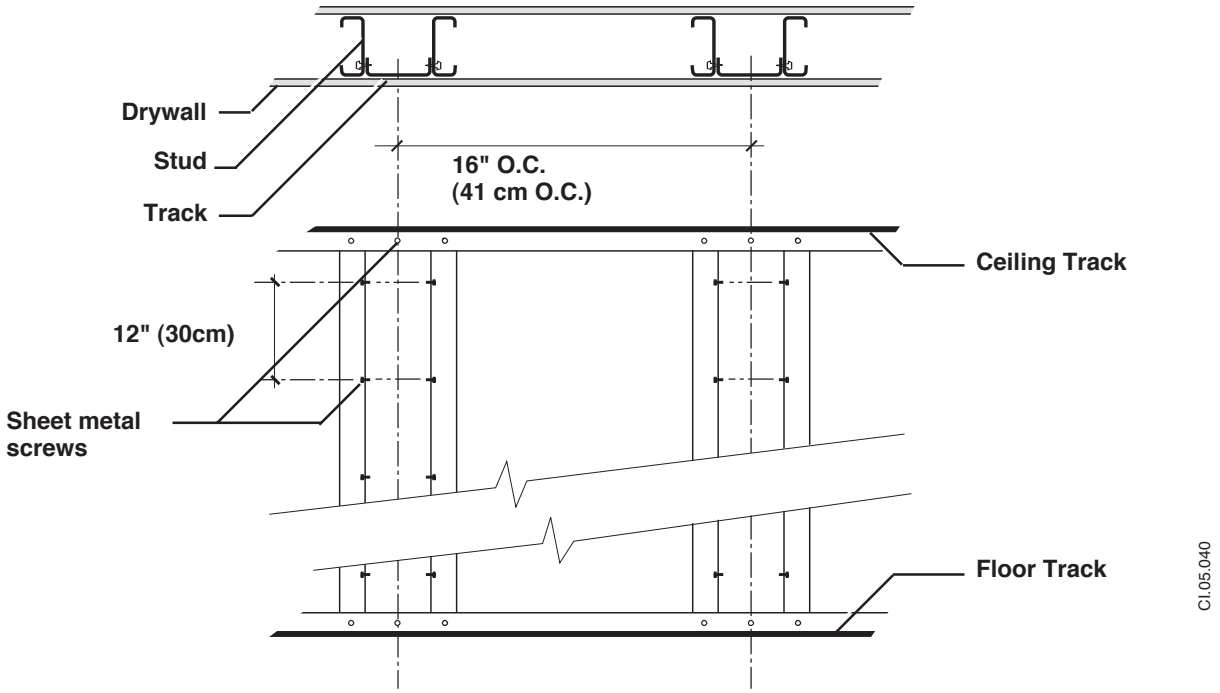


Figure A-5
Wall Cross Section

Warmer Installation

After the wall is finished and the room is completed you are ready to install the warmer. The distance from the warmer heater head to the bassinet or bed mattress surface is critical for proper operation of the warmer. This distance must be 27-2, + 9 inches (69-5, + 23 cm). Before installing the model 3050 or 3100, you must determine the bed surface height that will be used (for your convenience, a bed height label is provided to attach to the wall to aid in visually aligning the bassinet/bed surface).

1. Locate the stud edges by pre-measurement or by using a stud finder. Find the center of the drywall track 3-3/8 inches (86mm) over from the stud edge. See Figure A-6.

2. Remove the hinge bracket from the warmer by removing the (2) hinge pins (one on either side) that secure the bracket to the warmer heater head.

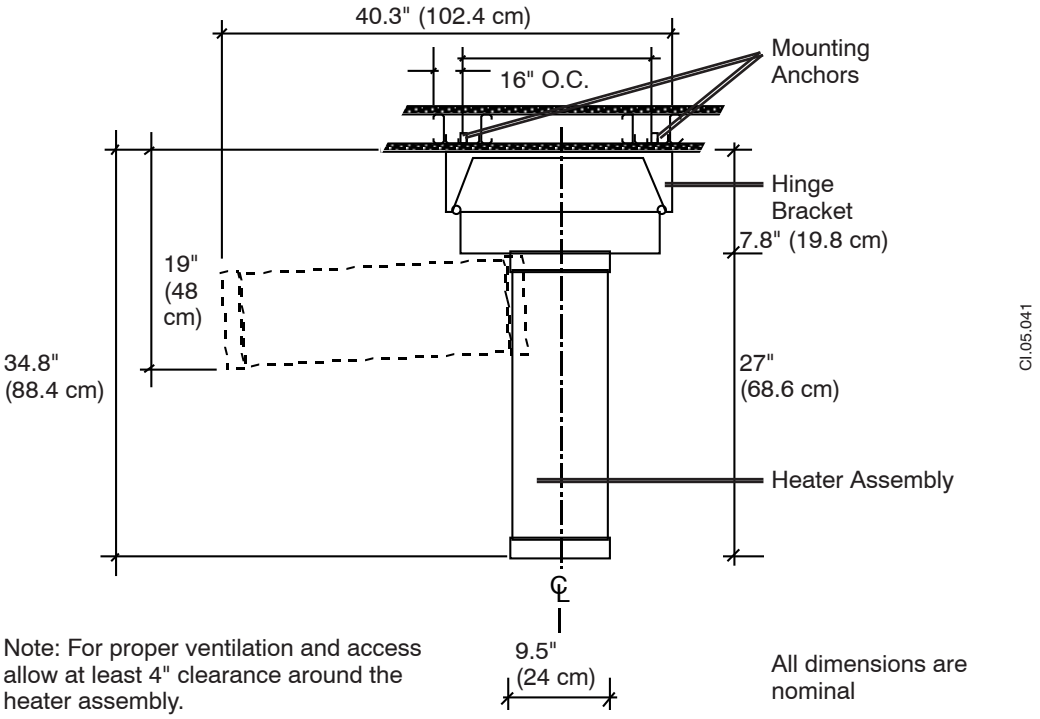


Figure A-6
Over head view

3. Utilizing a level, position the hinge bracket on the wall. The bottom edge of the heater mounting bracket on the model 3050 and 3100 must be 27-2, + 9 inches (69-5, + 23 cm) from the bed surface of the mattress that will be used. See Figure A-7. The model 3150 integral bed warmer already comes with 27 ± 2 inch (69± 5cm) bed-to-heater spacing.

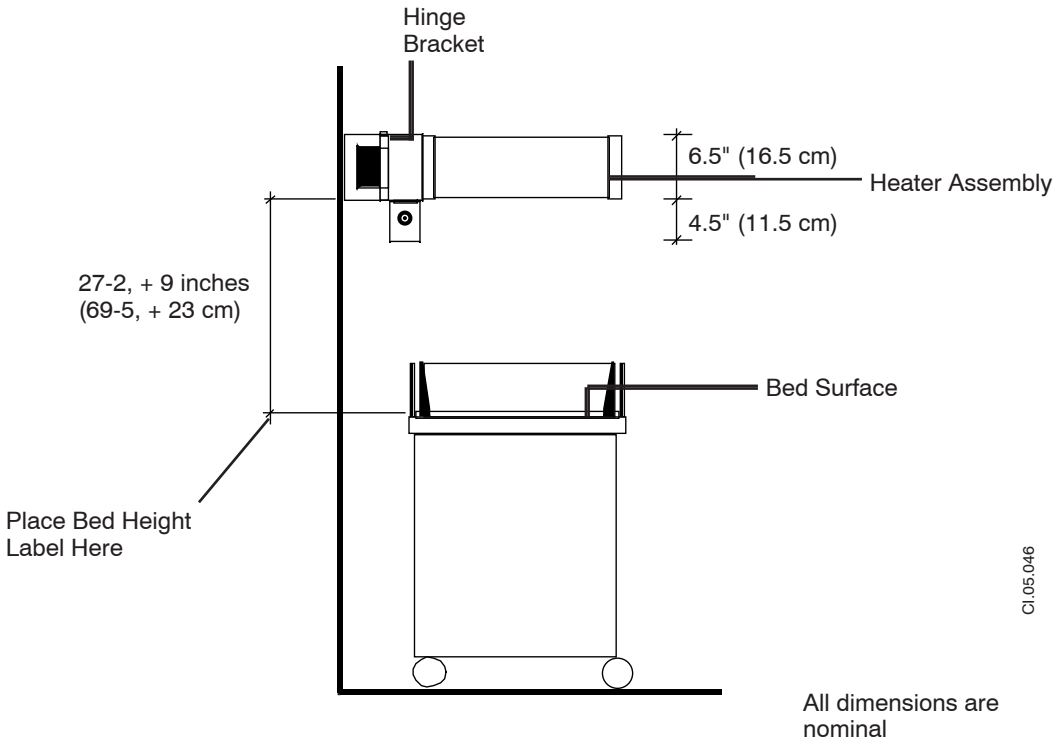


Figure A-7
Heater to bed spacing

4. Use the hinge bracket as a template to mark the mounting holes on the wall.

5. Use a 3/4 inch (19mm) diameter metal cutting hole saw to drill (4) holes through the dry wall and through metal drywall tracks behind the wall.

WARNINGS

⚠ **When installing wall mounted units, to achieve adequate structural strength all four holes must engage tracks. Should the hole saw miss a track do not proceed. Consult the project engineer for further direction.**

⚠ **Enclosing the heater assembly inside a cabinet may prevent proper ventilation and may create a fire hazard. If the heater is enclosed in a cabinet, it must be equipped with a power cut-off device that prevents operation while the cabinet is closed.**

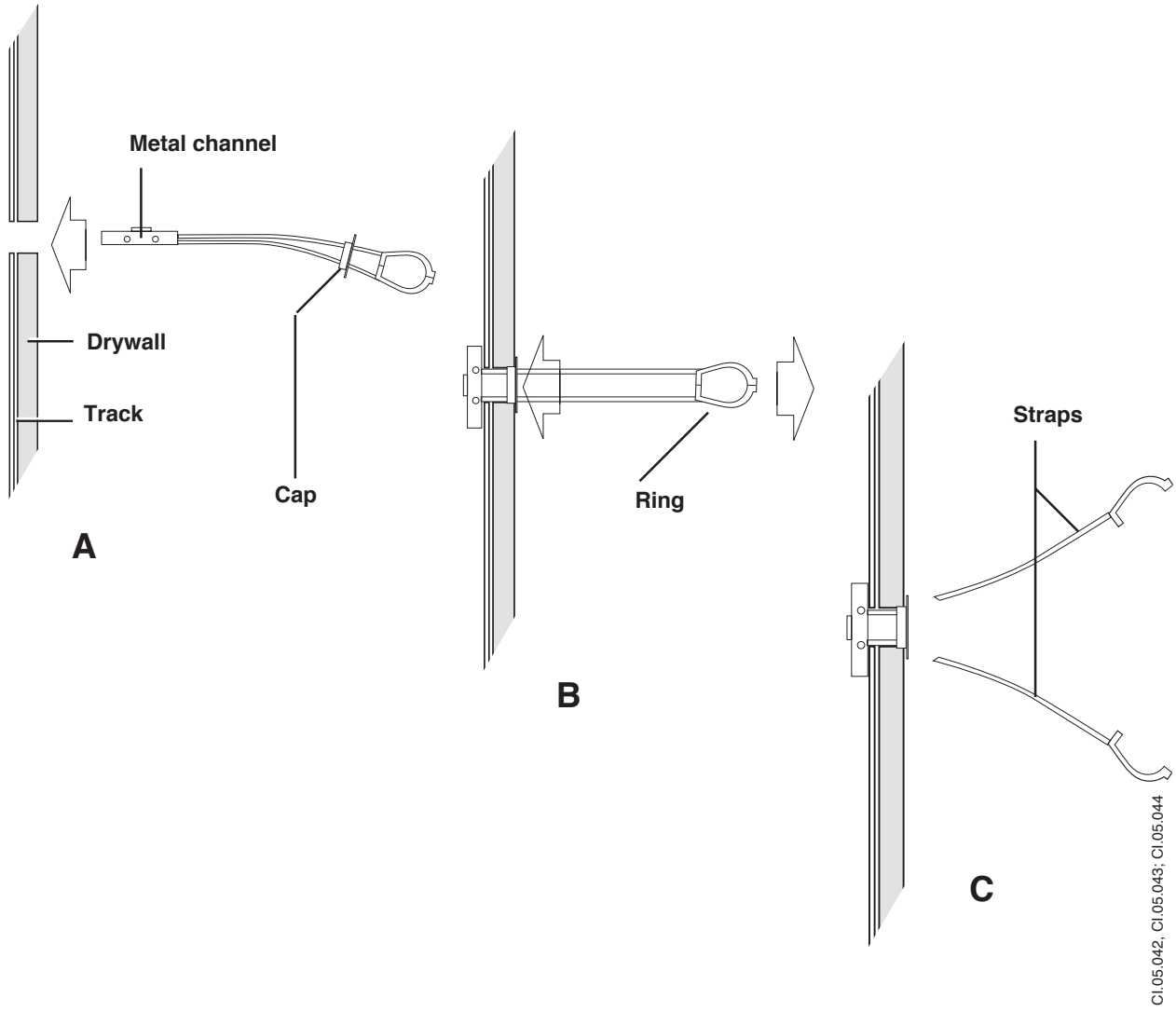


Figure A-8
Anchor installation

6. Perform steps A through C to secure the (4) Toggler® anchor bolts in the wall. See Figure A-8.
   A. Hold the metal channel flat alongside the plastic straps and slide the channel through the hole in the wall and track.
   B. With one hand, hold the ring so the metal channel rests flush behind the wall. Slide the plastic cap along straps with the other hand until the flange of the cap is flush with the wall.
   C. Place your thumb between the straps, and push from side to side, snapping off the straps level with the flange of the cap.
7. Mount the hinge bracket on the wall with the flat washers, split ring washers and screws provided. See Figure A-9. Tighten the screws with approximately 80 lb/in of torque.

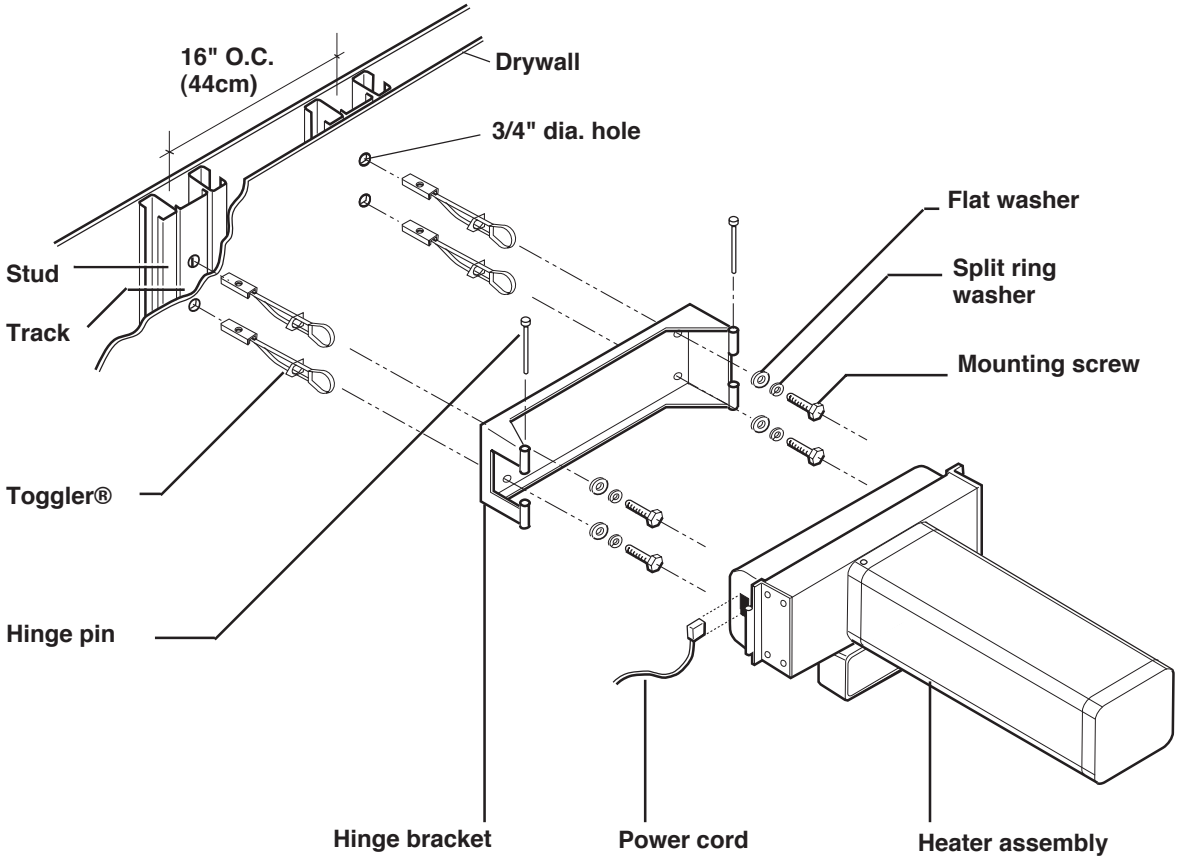


Figure A-9
Wall mounting

Note: The screws provided (3/8 - 16 UNC, 2 1/2" long) are for installations in 1/2 inch or 5/8 inch thick drywall. For applications involving double thicknesses of drywall, longer screws will be required. To properly mount the warmer, at least 2 a screw threads must be engaged.

Verify that the bracket is level and the distance to the bed surface is 27 inches, ± 2 inches (69 ± 5cm).

WARNING

⚠ Keep hands clear of the hinge area when installing a wall mounted heater assembly. A possible pinch hazard exists .

⚠ The 3050 heater assembly weighs approximately 30 lbs (14 kg). Proper installation may require two people. Due to the weight of the 3100 and 3150, the 3100 weighs approximately 75 lbs. (34 kg) and the 3150 weighs approximately 110 lbs. (50 kg), proper installation will require two people.

8. Mount the warmer by inserting the back of the unit into the hinge bracket mounted on the wall, then securing it by tapping in the (2) hinge pins. Verify that the heater assembly is rigidly secured to the wall, is level, and is parallel to the floor.
9. For the model 3050 and 3100, attach the "proper bed to heater spacing" label provided with the unit to the wall so that the bottom line of the label is 36 inches (74 cm) from the lower edge of the hinge bracket.

WARNING

⚠ Heater spacing less than 25 inches will result in incorrect operation and may adversely affect patient.

For the model 3100 or 3150 perform steps 10 through 15. For the model 3050 skip to step 15.

10. Using the lower hinge bracket as a template mark the mounting holes on the wall for the lower bracket.
11. Remove the warmer from the wall by tapping out the (2) hinge pins from the upper bracket.
12. Remove the lower hinge bracket from the warmer by removing the (2) hinge pins (one on either side) that secure the bracket to the warmer.
13. Repeat steps 5, 6 and 7 to properly install the lower mounting bracket.
14. Mount the warmer by inserting the back of the unit into the upper hinge bracket mounted on the wall, then securing by tapping in the (2) hinge pins. Secure the warmer to the lower mounting bracket by tapping in the (2) hinge pins. Verify that the heater assembly and side rails are rigidly secured to the wall and that the heater is level and is parallel to the floor.
15. Refer to the Operation & Maintenance Manual for checkout procedures.

WARNING

⚠ Perform Checkout Procedures before placing the unit in operation.

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